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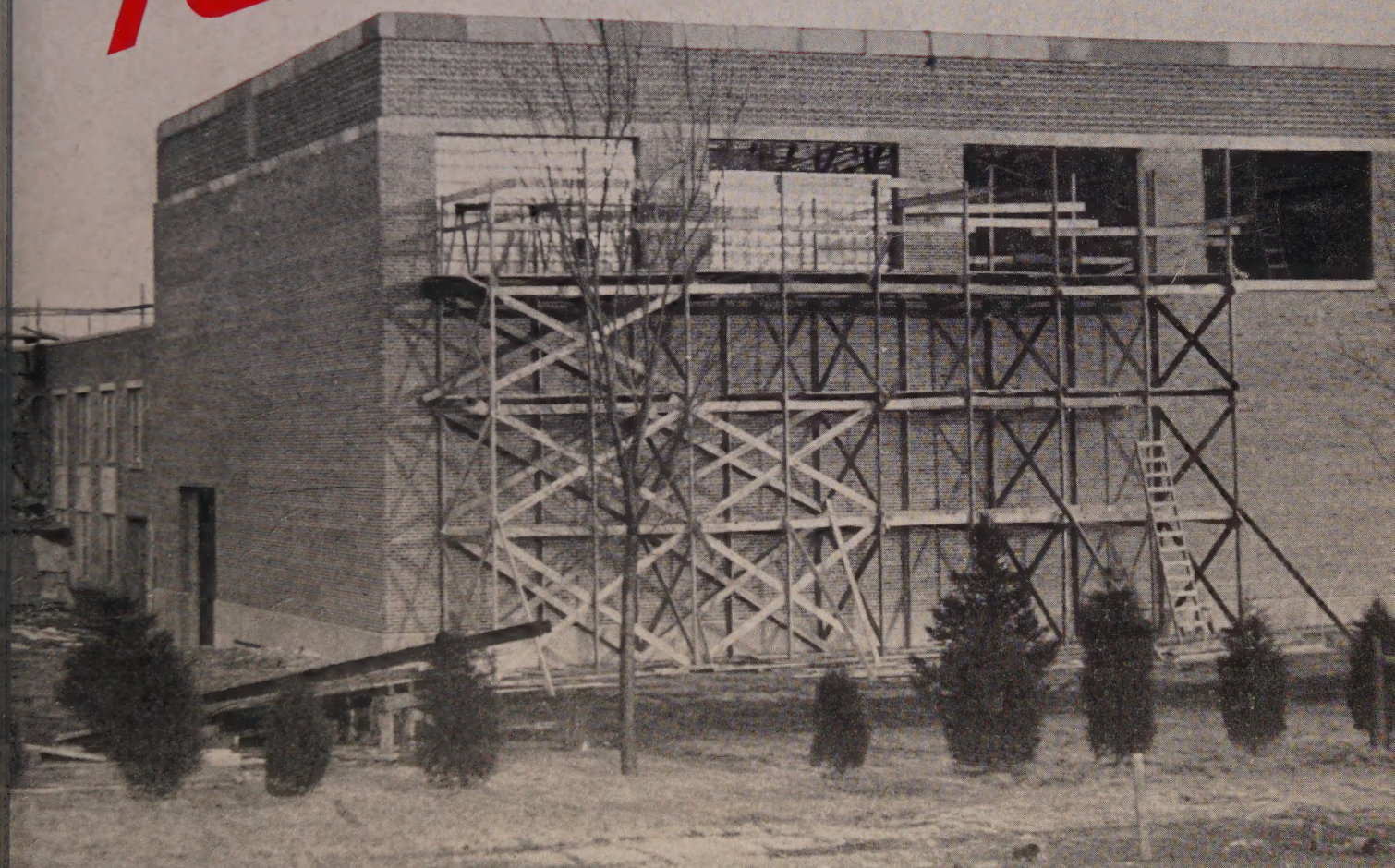

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Television today is clearer, sharper, and brighter—thanks to the improved kinescope, or picture tube, perfected at RCA Laboratories.

The Picture Tube that brought "life" to television

The screen on your home television table model receiver is the face of a large picture tube. And the skater you see on the face of the tube is the *identical twin* of the skater being televised.

Pioneering and research in RCA Laboratories led to the development of this tube which allows none of the original realism to be "lost in transit." It reproduces everything the television camera sees, shows you every detail, keeps the picture amazingly lifelike and real.

An RCA Victor television receiver brings you all the action, drama and excitement that you'd enjoy if you were at the event in person—and on top of that it's all brought to you in the comfort of your own home . . . you don't have to move from your favorite chair.

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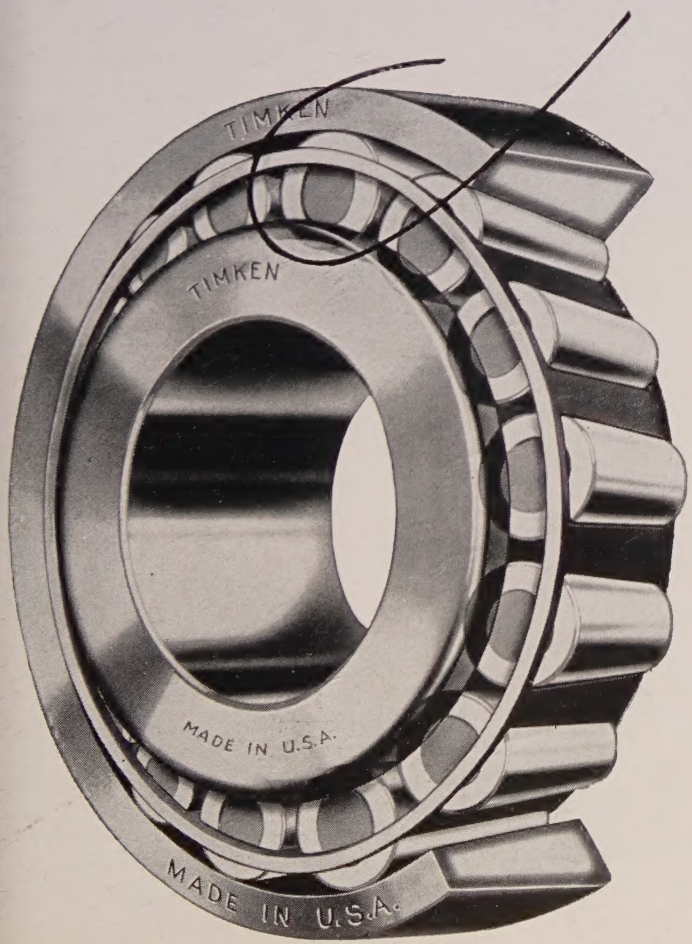
A BEARING QUIZ FOR STUDENT ENGINEERS

Do you know that over 90% of all modern bearing requirements can be met adequately with the Timken Tapered Roller Bearing? That in this one precision mechanism is contained a multiplicity of abilities which when fully appreciated and properly applied can overcome any bearing condition you ever may encounter?

Do you know that the Timken Roller Bearing is more than an anti-friction bearing; more than a radial load bearing? That it is an all-load bearing — can carry, all at once, radial loads, thrust loads, and any combination of them with full efficiency and certainty?

Do you know that the Timken Bearing was introduced nearly 50 years ago and has undergone constant engineering development and refinement ever since? That the Timken-developed process of Generated Unit Assembly produces true spherical (convex-concave) contact between the large ends of the rolls and the rib or flange of the cone thereby reducing friction and initial wear to a minimum; assuring correct alignment of the rolls with respect to the races; helping to distribute the loads evenly throughout the bearing; decreasing operating temperatures; producing quieter running; and last, but not least, assuring that when the bearing is properly mounted no further adjustment is required?



Do you know that the special alloy steel from which Timken Bearings are made was developed in our own metallurgical laboratories and is produced in our own steel plant? That the Timken Bearing is the only bearing manufactured under one roof from raw material to finished product?

Would you like to know more about the Timken Bearing, particularly how it can help you in your engineering career? Write us. The Timken Roller Bearing Company, Canton 6, Ohio.

New Developments

by Martin Sabath, M.E. '47
and Jerry Mathews, M.E. '47

Plastic Bearings for Research

To see what is happening on the inside of a bearing seems like a fantastic dream in the minds of engineers, yet unique experiments with transparent plastic models of machine bearings are revealing important statistics. Heretofore only "mathematical guesses" could be made to determine what happens to bearing oil under various loading conditions.

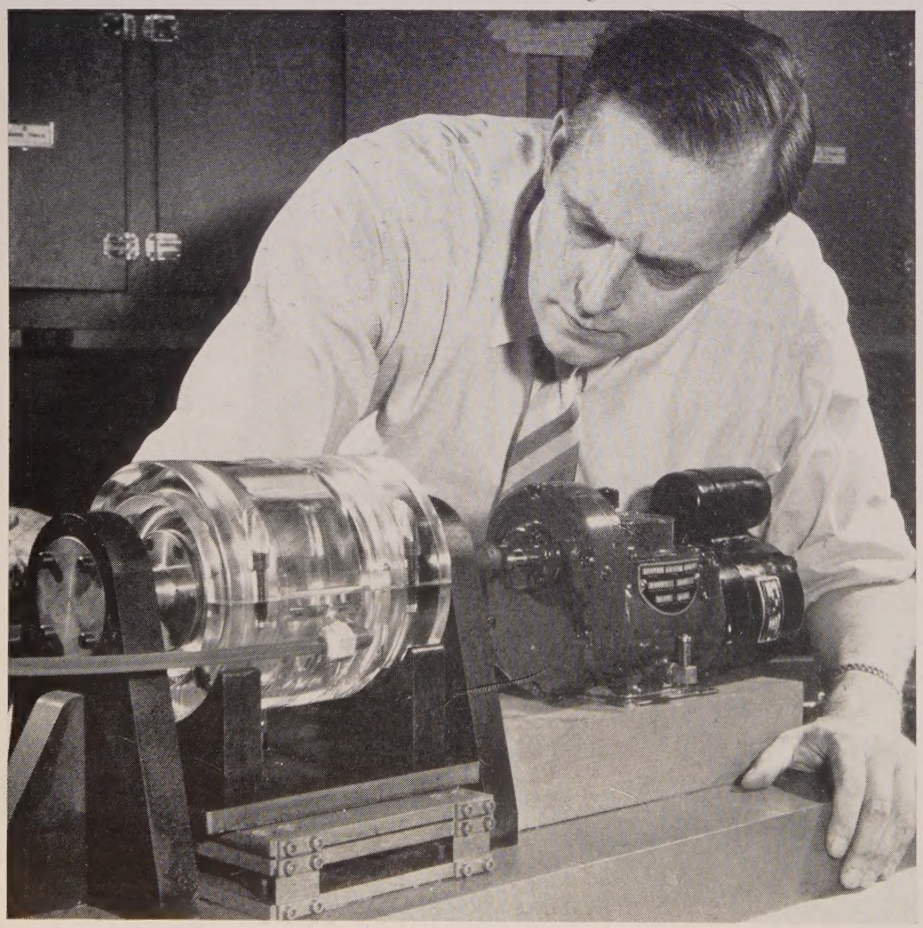
The procedure now is to color oil with a red pigment and feed it into the bearing model to actually observe lubrication effectiveness. Whether the seals work properly, oil passages are enabling a proper flow of the lubricant, and the relief points are located correctly and can readily be seen. Thus, much trial and error has been eliminated in the design of bearings. Already, through this method, machines of larger power producing heavier loads on the bearings have been made without any increase in size or weight.

A transparent plastic called lucite is machined to close tolerances, just like metal, to form the models of bearings and journals. During the actual test, the rotating element of the model is operated by a hand crank for slow speeds and is motor driven for high speeds.

As the red colored oil works its way through the bearing, engineers can see whether the grooves which distribute the oil are properly placed to do a thorough job. If these oil passages are not in the right position, some areas will have no lubrication; and the bearing will not be able to carry a full load.

Surface Attention

Rust and corrosion causes much annual loss on exposed metal, and lost metal means lost money. And when money is involved, well—look out rust!



Lucite machine bearings permit study of lubrication flow

The electron diffraction high temperature camera

The causes of rust and corrosion ar hidden in a layer of atoms so minut that 6,000,000,000 of them woul weigh little more than an ounce. A ticklish problem (similar to the kin you get in M. E. 14) is to find ou what happens when this invisible bound ary zone comes into contact with ai The problem has not been solved (re member M. E. 14) yet. Dr. Earl A Gulbransen, who is doing the researcl has approached the study of the proble in a very unique fashion. His studie are eventually aimed at providing way to produce better tin plate, cheape stainless steel, stronger gas-turbine blad ing, and longer-wearing bearings fo engines.

This involves some very precise meas urements which have been made by: 1 the electron microscope; 2, the elec tronic diffraction camera; and 3, th vacuum microbalance.

The electron microscope, which re veals what the coating looks like, mag nifies this thin film 50,000 times b means of a high voltage beam of elec trons which passes through the sampl and is pulled outward by magneti fields along the sides of the microscop The magnified image, produced by tw successive spreadings of the beam, recorded on a strip of photographic fil in the form of a shadowgraph.

The electronic diffraction camera, re vealing its chemical nature, again use

(Continued on page 38)

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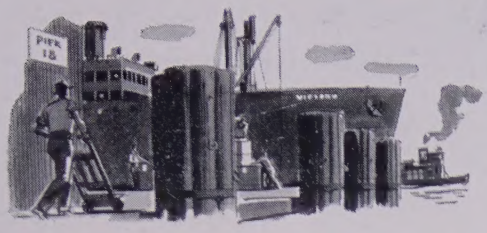
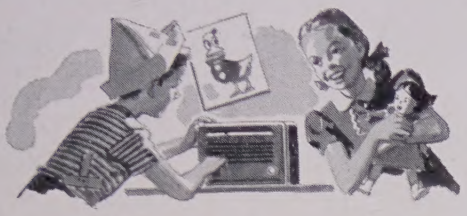
What did you do today?



If you visited the waterfront[1] . . . . . or watched a plane[2]



. . . or turned on the radio[3] . . . . . or boarded a bus[4] . . . .

. . . saw a freight car[5] . . . . . or went to the dentist[6] . . . .

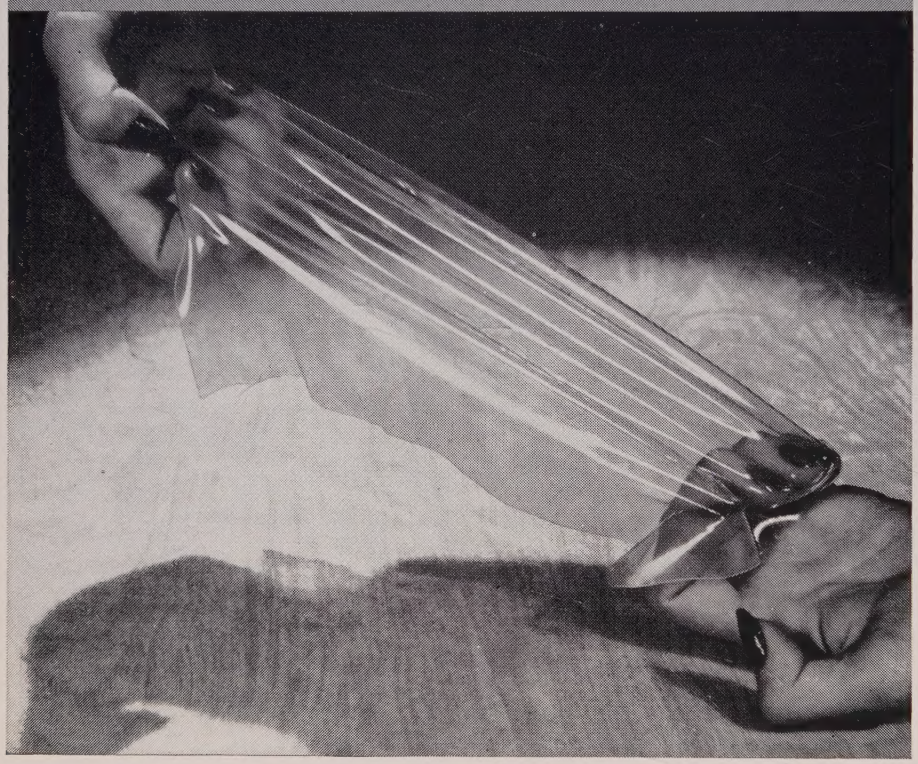
. . . lighted a candle[7] . . . . . or bought a necktie[8] . . . . . .

you saw a Koppers product in use[9]

1. Wood piling, pressure-treated by Koppers to protect it against marine borers. **2.** Koppers Aeromatic variable-pitch propellers. **3.** Koppers chemical ingredients for plastic radio cabinets. **4.** Koppers American Hammered Piston Rings. **5.** Wood for car construction, pressure-treated by Koppers for extra-long life. **6.** Koppers chemical ingredients for novocain. **7.** Koppers candles. **8.** Koppers chemicals for use in making dyes. All these are made by Koppers . . . as well as scores of other useful and familiar things. All bear the Koppers trade-mark of quality . . . the symbol of a many-sided service. Koppers Company, Inc., Pittsburgh 19, Pa.

Researchers develop unique coating material

DOW LATEX 512



Unmodified films of Dow Latex 512 are strong and highly elastic.

Students majoring in chemistry will find much to interest them in our new coatings laboratory where technicians are developing significant new materials through research. Dow Latex 512, recently introduced, is a good example of what goes on in this laboratory which is an activity of the Dow division devoted to resins, latices and plasticizers.

Dow Latex 512 is a coating material that promises great usefulness in the paint, paper, textile and adhesive industries. Its principal film forming ingredient is based on a copolymer of styrene and butadiene. On air-drying it forms a rubbery, protective film. It is compatible with conventional coating materials and possesses good stability under agitation and freezing, excellent pigment-binding characteristics and high protective values.

Dow research is continuous in all divisions and there are many fields for young technicians who are preparing for this type of work.

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CHEMICAL COMMENTS

Flexible Heat for Paint Processing

Flexible heating systems are a necessity to many paint and varnish firms, where high-temperature processing requirements vary widely. In one Midwest finishes plant, where processing temperature requirements vary from simple heating to complex sequences of heating and cooling, Dowtherm, the high-temperature, low-pressure heat transfer medium has been installed. With this indirect heating system they have found that temperatures can be adjusted easily for every specific job. The company uses a 3,000,000 Btu/hr. Dowtherm vaporizer for heating and an independent liquid-phase Dowtherm cycle for cooling. Simple controls permit the two cycles to be coordinated for a variety of temperature combinations. (Since installing the Dowtherm system, the company has found that heating is more efficient, processing more uniform, equipment is simpler and larger batches can be processed at a time.)

Disinfectants Produced from Phenol Derivatives

Phenol derivatives are now being used in the manufacture of many disinfectants. These phenol products, produced by Dow, are known as Dowicides. They are noted for their high germ killing powers which are largely retained in the presence of organic matter. Other important properties: excellent compatibility with cresols, pine oils, soaps, low toxicity, and absence of color and odor. These qualities indicate the wide adaptability of Dowicides to the manufacture of bactericides and fungicides.

Mold in Foods Prevented by Dow Propylene Glycol

The food industry is making increasing use of low-cost Dow propylene glycol to keep many types of eatables palatable and healthful, without risk of mold. . . . This is a highly purified material of pharmaceutical quality, free from odor and taste. . . . By adding small quantities of Dow propylene glycol, food processors can prolong freshness in foods—retain full flavor—and actually decrease danger of mildew.

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND AGRICULTURE

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OUR COVER

Typical of the enormous construction work now in progress at the University is the almost-completed betatron laboratory on south campus.

FRONTISPIECE

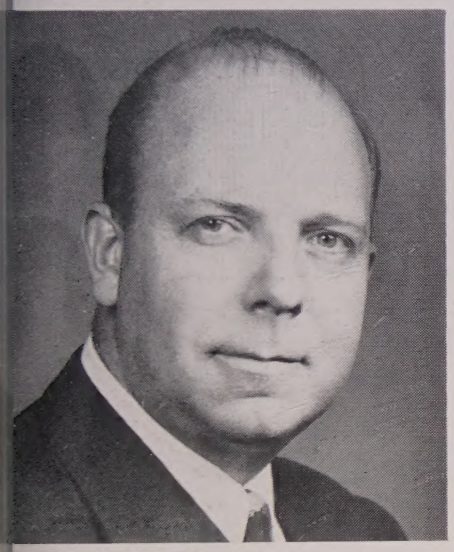
This resistance welding machine is shown as the operator butt-flash welds a rotor ring for a large generator. Heated to about 3000° F., the two ends of the ring are slammed together by remote levers to complete the weld. (Courtesy of General Electric company.)

Electrical Research Program

by Dr. F. D. Bennett, E.E. Dept. and John Dick, E.E. '49

During the past eighteen months research activity within the electrical engineering department has been greatly increased as a response to the problems posed by return to peacetime and the unprecedented demand for engineering training. The need for expanded research facilities is especially evident in the graduate division where the number of students desiring advanced work in electrical engineering has increased by more than twenty times.

The spirit and tradition of research



Dr. Everitt, head of the electrical engineering department

in electricity and magnetism and allied subjects has been carried out in the past by such men as Dr. Tryge Yensen, Professors J. T. Tykociner, H. A. Brown, C. T. Knipp and many others. Dr. Yensen, now with Westinghouse Electric company and who is well known for his work on the magnetic properties of iron and iron alloys, started his research at the University of Illinois shortly after World War I. Photographic and photoelectric reproduction of sound and its direct application to the motion picture industry was developed here by Professor Tykociner. This led to the sound motion picture which was first demonstrated at the University in June, 1922, six years before it was used commercially.

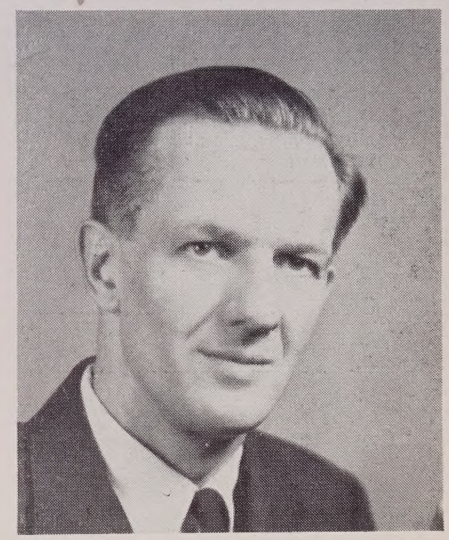
The value of fundamental research has long been known to scientists and has been more generally appreciated by the public during the recent war years and those immediately preceeding. The phenomonal effect of science on the outcome of the war, felt through the invention and utilization of such devices as the atomic bomb, radar, the proximity fuse, and jet propulsion, exemplifies the immense harvest derived from the scientific principles already recognized.

Just recently a new research group has been activated in the electrical engineering department, and in this and subsequent articles the Technograph will present some of the research projects at present in progress. This first article deals principally with purpose and aims of the group and briefly outlines some of the more important plans.

The problems of the future, made more complicated and immensely more urgent by the destructive devices produced during World War II, demand solutions for which answers can be found only through increased original, fundamental research. In a sense, we have capitalized on the stockpile of research discoveries made during the past 50 to 100 years. We now need to replenish this stockpile of knowledge. Nowhere is this more evident than in the field of man's understanding of himself and his fellow man. The crucial urgency of the social adjustment problems now facing mankind have forced on all research groups an ever-widening complex of fundamental problems demanding group efforts of scientists with widely varied backgrounds and training.

Mankind sorely needs improved, precise knowledge of the functioning of the human nervous system, and of the interaction between biological systems and all types of mechanical, electrical, and radiation forces. A possible approach offered by electrical engineering for these problems is to provide improved electronic instrumentation and technique to make possible increased accuracy of measurements, and thereby give a sound basis for theoretical and analytical speculation. Modern problems of remote control, propagation of electromagnetic radiation, production and detection of radiation, production and analysis of acoustic radiation fields, and the study of high voltage generators and particle accelerators all fall, to some extent, within the scope of progressive, original electrical engineering research. The present research program in the electrical engineering department at the University of Illinois is designed to provide these regions of contact between the scientist and the problems of modern society.

As by-products of a vigorous research program will come increased stimulation of students and faculty alike into methods of original inquiry; so also will come a steady flow of research trained scientists and research stimulated engineers. The experience of recent years has shown conclusively that the men most capable of significant scientific and engineering contributions are those with experience and background in original inquiry. The new research effort provides for the training of such men.



Dr. DeVore, chairman of the electrical research committee

In organization the new laboratory provides a maximum of flexibility for stimulation and production of new ideas and trends in research. A committee, responsible to Dr. William L. Everitt, the head of the electrical engineering department, guides the program of research for the laboratory. The committee recommends projects and programs consistent with the interests of its members, who represent all branches within the department. The chairman of the committee is Dr. Lloyd T. DeVore, who has recently joined the faculty of the University. Dr. DeVore has had exten-

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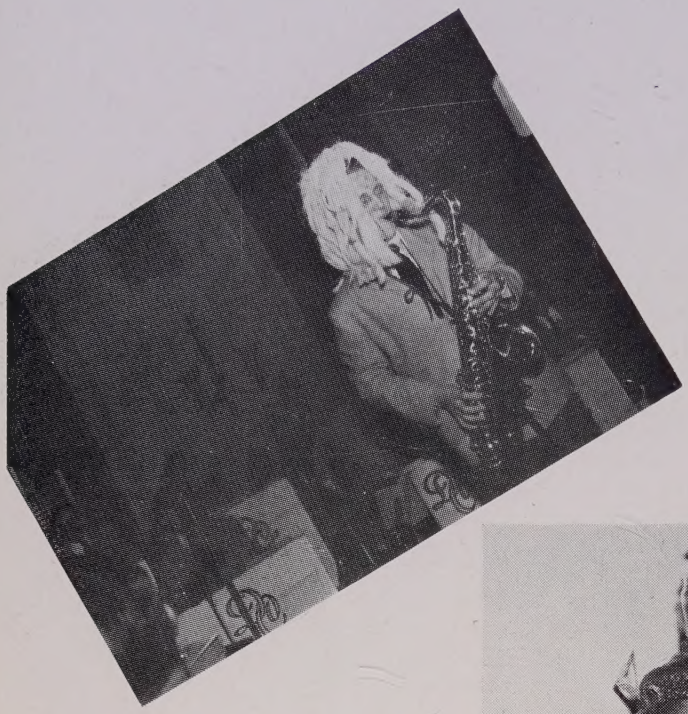
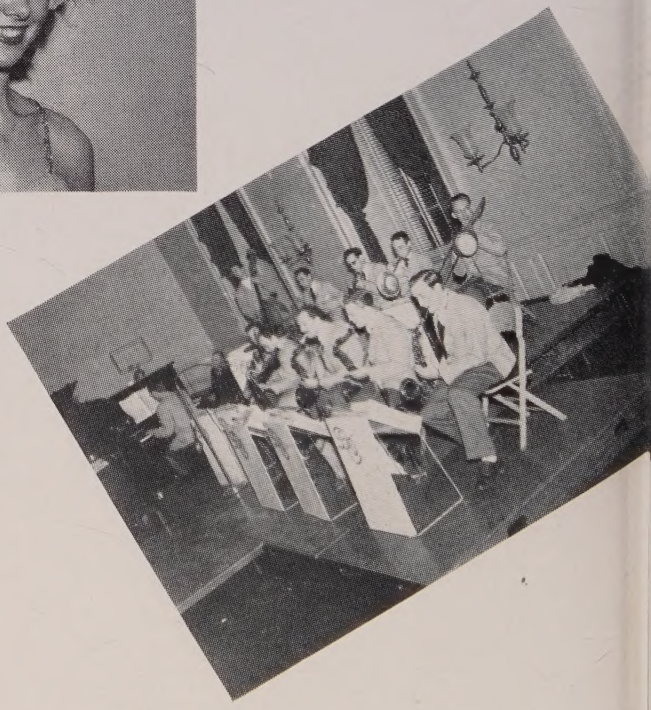
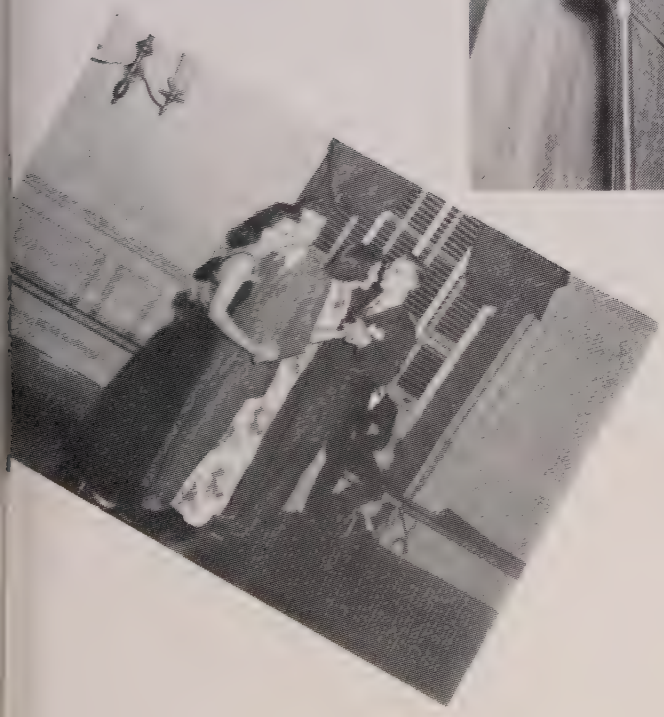
St. Pat's Ball



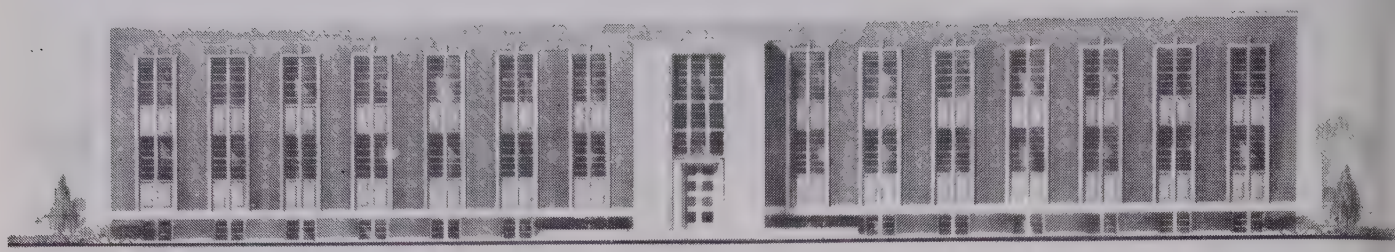


Upper left: A hot solo. Upper right: Left couple, unknown. Right couple, Marilyn Gregg and Carl Lantau. Center: St. Patricia, Rae Ring. Lower left: Bill Randolph and Art Leininger conducting balloting for St. Pat and St. Patricia. Lower right: Dick Cisne's Band.

Tops Them All



Upper left: Walter Polanin, Elvira Vigna, Earle Bell, Bill Randolph, Marie Polanin, Gladys Schmetter, William Huelsen, Jeanne Huelsen. Upper right: What a Piano! Center: St. Pat and St. Patricia, Chuck Fago and Rae Ring. Lower left: Flo Ketzle, George Foster, Rosemary Storm, and Ed Sjunnesson. Lower right: Mr. and Mrs. Chet Sokolowski and some of the crowd.



The University's . . .

New Electrical Engineering Building

by Francis Green, E.E. '48

A new building of modified Georgian design is now in the initial stages of construction on the corner of Wright and Green streets. Replacement of the Health station and former president's home by this structure for the electrical engineering department of the College of Engineering is to contain recitation, laboratory, shop, and office space for about half of the present electrical engineering students and staff. It will cover an area extending 213 feet along Green street and 141 feet along Wright street, and therefore is of large enough proportions to necessitate straightening and rechanneling the famous Boneyard creek to a position a few feet north of its present location. The exterior design and use of Indiana limsetone and brick have been selected to harmonize as closely as possible with Talbot laboratory, Engineering hall, and the Illini Union building.

Of the principal entrances to the structure those on the east and west will have ornamental iron railings on the outside, and the main entrance will have a small patio surrounded by evergreens. Each of these doors lead to the main interior corridors up short flights of stairs. Inside the main entrance there will also be stairways leading to the ground floor where the unusually large circuits and machines laboratory is to be located. Recessed in the concrete block walls of the corridors will appear first aid and fire cabinets.

This article about the electrical engineering laboratory deals only with the completed building. Anyone interested in information on the construction details please contact Professor A. R. Knight, chief sidewalk superintendent. Mr. Knight may be found almost any time in his open air office at the corner of Wright and Green streets. In his absence either of his chief sidewalk supervisors, Professors C. E. Skroder or M. Stanley Helm, will usually be present to direct the rubbernecking activities.

The laboratory just mentioned is to be 140 feet by 80 feet in dimensions and entirely without outside exposure, except for the receiving well for trucks at the rear of the building. It will accommodate 40 to 50 study squads at a time. All lighting facilities will be fluorescent fixtures capable of sustaining 50 foot-candles illumination, in comparison to the present machines laboratory level of about 10 foot-candles. Opening directly into the room from the rear will be discussion rooms wherein several groups can get off the floor and out of the way of experimenting squads to discuss material and techniques to be ap
plied after reentering the lab. In addi
tion to these there will be the powe
room, insulated from the rest of th
building by 16 inch concrete, and th
electroplating, woodworking, metal
working, and arc-welding shops, a
along the north side of the main labora
tory. On the west are the instrumen
storage, and repair and calibratio
rooms. At the front of the buildin
there will be classrooms, for use wit
demonstration media, and a number o
offices. Finally, the meter relay labora
tory, supply storeroom, and freight el
vator, which extends to the roof, wi
be situated on the east side. A dumb
waiter installed in the instrument roo
will give students access to service fro
the main and second floors without ha
ing to negotiate several flights of stair

The main floor is to be less than 10
feet in depth. As a result, the central
located laboratories and rooms north
the corridor connecting the east an
west entrances are somewhat less tha
half the size of those on the groun
floor. Here will be located the serv
mechanism and research laboratorie
the electrical design and instrument d
sign rooms for students in power optio
a seminar room, and several classroom
Along the front will be found offic
the staff conference room, and the d

(Continued on page 38)

ampus Contemporaries . . .

by Dorothy Collier, L.A.S. and Jim Leeming, Ch.E. '50

WARREN DAY

At present a senior in civil engineer- Warren Day has long been planning his future after graduation. Some e ago Warren had an opportunity to k with a group of engineers who were o missionaries, and this conversation nted in him the seed of interest which s now blossomed into a sincere desire develop in this field. This means that er graduation his studies will actually starting all over again. In order to pare adequately for the job he wants do, Warren plans to enter a seminary on graduation from the University. is plan will, at the same time, fulfill desire to further broaden his educa- n—a feature which Warren feels was lly inadequate in his engineering cur- ulum. As a full-feldged missionary-

WARREN DAY

gineer, he plans to eventually work ith one of our world neighbors to help ing the benefits of education and en- ghtenment to those less fortunate than rselves.

Warren's less ambitious, but equally tive, days were spent largely in Cen- alia, Illinois, where he finished gram- ar school. The Day family then moved Carbondale in time for Warren to tend high school. During the latter our years in high school, he became in- rested in and played on the basketball am, and, even though time didn't per- it, one of his greatest pleasures was laying the clarinet in the concert band. Graduated from high school as vale- ictorian of his class, Warren, shortly afterwards, was called into service and entered the navy in July, 1944. For his first assignment with the navy V-12 unit Warren was stationed at Illinois Normal where his interest in basketball again asserted itself. A short time later he was transferred to the V-12 unit here at the University of Illinois; and although discharged from the navy about a year later, Warren remained here to complete his work in civil engineering.

Even though his school work keeps him sufficiently occupied to eliminate the problem of spare time, Warren still finds the time to take an active interest in his church, the McKinley foundation council, and the YMCA cabinet. He is also a member of Chi Epsilon and Tau Beta Pi, and only regrets that there wasn't sufficient time in his engineering curriculum to work in more socially broadening courses necessary to attain his goal as a missionary-engineer.

JIM RYAN

"You don't have to twist my arm very hard to talk me into a milkshake at Kam's," said this likeable Irishman, Jim Ryan, when asked for an interview. It seems that socializing and loafing are his favorite pastimes if, and when, he has time. Jim, a junior in engineering physics, claims Mattoon as his home town, although he was born in Chicago. "Chicago doesn't count," he says. "I left there while I was still in diapers." He went to Mattoon senior high where he took an active interest in ROTC and the student council.

Illinois was his choice for a number of reasons; it was close to home, he had a brother here, and then the obvious one, it has a good engineering school. In the fall of 1940 he enrolled in engineering physics. When asked why he chose physics he said that it was mostly because of his like for high school physics although, "it's quite a bit different up here." Jim became a member of Scabbard and Blade, Pershing Rifles, Tomahawk, and Tau Nu Tau.

He entered the service in June of 1943 where for a short time he was in the engineers. He was soon transferred to the air corps where he was commissioned as a lieutenant in navigation. Jim is very reticent about his experiences in the Pacific except that he is a member of the "Sea Squatters" due to a "little" incident off the coast of Japan.

In the fall of 1946 Jim reentered Illinois. He is now working part time as an assistant laboratory instructor in physics and is also helping to reactivate Scabbard and Blade. All this work does not give him much spare time for his two favorite sports, swimming and bowling. Jim hopes to go into research work when he graduates.

JIM RYAN

New Sand Binding Agent

A new type of binding agent in molding and core sands for production of gray iron castings is now commercially practical. It has been developed by a southern foundry after a long period of development work.

The binder is a plastic or synthetic resin. No water is used with molding sand; the adhesive or binding property being developed under pressure. The resin is spread through core sand by means of a solvent, which can be recovered during baking and reused.

In marked contrast to customary bonding materials, only a small part of the resin burns out of the molding sand during pouring; and the sand can be reconstituted with an addition of 0.25 per cent resin.

Among its numerous advantages is smooth peeling from castings. Lowered cleaning costs and improved finish of the casting are also achieved.

Saluting Salt Lake City

Salt Lake City—not New York City, as is generally presumed—installed the world's first electrically interconnected traffic signal system, in 1917. The world's second largest city didn't do much about its traffic problem until 1919 when a traffic tower, with floodlights on top, was erected on Fifth avenue at Forty-second street.

State of Illinois . . .

Professional Engineering Examination

The so-called "Grandfather clause" of the Illinois Professional Engineering act became inapplicable after the first year of its life, except for any person who, at the effective date, July 20, 1945, was ". . . on active duty with the armed forces of the United States, including the United States merchant marine . . ." Consequently, any application from a non-veteran for registration as a professional engineer in the State of Illinois, bearing a postmark later than midnight July 20, 1946, must be considered under the requirements of the law in what may be assumed its revised form.

Problems connected with the normal operation of the act have never been far from the minds of members of the examining committee and frequently have been discussed at its meetings. However, overwhelmed with some 16,000 applications during the first year, it was not possible for the committee to formulate completely satisfactory plans for normal operation, before it was confronted with the necessity of building its first "post-grandfather" examination of applicants for registration, on November 19 and 20, 1946.

In order to keep the student acquainted with the latest developments in the professional field the Technograph is reprinting from the Illinois Engineer this copy of the state registration examination which was given on Nov. 19 and 20. Since this examination is required of all engineers desiring professional standing, it is advisable for the student to become familiar with its general form.

In preparing for the examination the committee met in Springfield on October 11, 12, and 13, 1946, at which time, after thorough discussion, the general character of the examination was decided upon, and preparation of questions for different parts assigned to appropriate members of the committee. A later meeting was held in Chicago on November 8, 9, and 10, 1946, for final discussion, advice, and assembly of questions.

In all its discussion of examinations the committee had before it a considerable number of published questions used by examining committees in other states. From the first the committee kept in mind as a guiding principle that standards for registration in Illinois must be at least as high as those in other states and, as a sort of measuring stick, decided to include in its first examination several questions taken verbatim from the published lists of those used elsewhere.

In order to acquaint members of the engineering profession in Illinois with what is being done the committee has accepted the offer of the Illinois Society of Professional Engineers to publish the November examination in the columns of the *Illinois Engineer*.

It should be stated that the committee is not satisfied in all respects with the November examination, and the whole problem of examination of applicants for registration under the Illinois Professional Engineering act is under continued study and development.

Professor T. C. Shedd, *Chairman*
State Board of Engineering Examiners

STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION & EDUCATION
DIVISION OF PROFESSIONAL ENGINEERING
Examination for Registration

PART I

Tuesday, November 19, 1946
8:30 a.m.

Answer eight but no more than eight of the following questions. If more than eight questions are answered only the first eight will be considered.

Return these question papers with your examination book.

1. Sketch on the accompanying sheet of cross section paper the area between the line $x = 30$, the curve $y^2 = 2x + 4$ and the x axis. Determine this area approximately. State how you would determine the area exactly.

2. Determine approximately the distance from the y axis to the centroid of the area in question 1. State how you would determine this distance exactly.

3. A plate 48 in. square is to be made into an open top box by cutting out corner squares and bending along the dotted lines in Fig. 1. Neglect laps for joints. What should be the size of the corner squares cut out to give the box the greatest possible volume? What will be the volume of the box?

4. If the degree of curvature is defined as an angle in degrees subtended by an arc of 100 ft.:

(a) Write the expression for the radius of a curve in terms of its degree of curvature, calling radius R and degree of curvature D.

(b) What will be the radius of a 5° curve?

5. The wheels of a truck are 5 ft. center to center, and its center of gravity is 6 ft. above the surface of the roadway as indicated in Fig. 2. What should be the angle of inclination of the roadway surface on a 5° curve to prevent

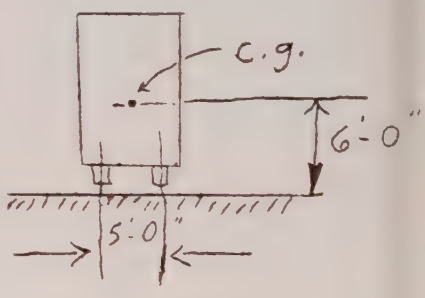


Fig. 2

any tendency to overturn at a speed of 40 m.p.h.? (Fig. 3).

6. Fig. 4 indicates diagrammatically a self-flushing tank, freely supported at A and pivoted at B. The inside dimensions of the tank are 10 ft. long, 6 ft. wide and 6 ft. deep. The tank is symmetrical and weighs 1260 lbs. What should be the weight of the counter weight to allow the tank to dump at the instant the water reaches a depth of 6 ft.? Assume that water weighs 62.5 lbs./cu. ft.

. 7. Fig. 5 shows diagrammatically a angplank pivoted at A and supported t B by an anchored pontoon. The gangank weighs 20 lb./sq. ft. of area, is ft. wide and has the length shown. he gangplank may be subjected a live ad of 150 lbs./sq. ft. of area, and under full live load the end C must not e depressed more than 12 in. The pontoon weighs 6 lbs./cu. ft. of gross volme, must have a freeboard of not less han 15 in. and may have a length of ot more than 35 ft. Assuming that ater weighs 62.5 lbs./cu. ft., suggest uitable dimensions for the pontoon.

. 8. Three tubes 1 in. o.d. and 7/8 in. d. are fastened side by side in a piece f equipment in such a manner that the engths cannot change. Assume that the iquipment is fabricated at +70° F. and hat in operation the tubes are subjected o temperatures from +150° F. to –10° F.

Given the following data:

	Modulus of Elasticity	Coefficient of Expansion or Contraction
Tube A	....30,000,000 p.s.i.	0.0000065
Tube B	....10,000,000 p.s.i.	0.0000013
Tube C	....14,000,000 p.s.i.	0.0000021

Calculate the intensitiy of stress and tal stress in each tube due to temperature changes.

9. This question consists of six items (a to f, incl.) each of which can be answered correctly by choosing one or more of the words or phrases given below it. Below each item circle the number or numbers of the answers you select. The fact that an item is expressed in the plural number does not necessarily indicate that it has more than one answer.

(a) Carbon dioxide is used:
1. by green plants during photosynthesis.
2. in making soft drinks
3. in making water gas
4. in solid form as a refrigerant
5. in the setting of gypsum plaster

(b) The combustion of a candle in a closed container of air will definitely result in:
1. no change in the total weight of container and contents.
2. an increase in total weight of container and contents
3. a decrease in total weight of container and contents
4. the formation of CO_3= ions
5. the formation of NO_2 gas

(c) Aluminum metal is obtained commercially by the
1. reduction of Al_2O_3 by C or CO
2. decomposition of alum
3. electrolytic decomposition of Al_2O_3 dissolved in molten cryolite
4. displacement of Al from clay
5. electrolysis of aqueous $AlCl_3$ solution

(d) Ordinary brass is an alloy of
1. copper and tin
2. copper and zinc
3. copper and iron
4. iron and tin
5. copper, tin and iron

(e) The United States depends upon other countries for a major portion of its supply of
1. tin
2. bromine
3. nickel
4. phosphate
5. "fixed" nitrogen

(f) Sulfuric acid is used commercially in the
1. lead storage cell
2. preparation of other acids
3. removal of iron oxide from iron
4. manufacture of nitroglycerine
5. preparation of $Ca(HSO_3)_2$

10. A ½-in. copperweld bar has a steel core ⅜ in. in diameter and a copper skin 1-16 in. thick. What is the unit shearing stress between the copper and steel for a rise in temperature of 75° F.? Use values of E of 30,000,000 p.s.i. and 15,000,000 p.s.i. and coefficients of expansion of 0.0000065 and 0.0000090 per degree for steel and copper respectively.

11. A heavy steel strut 10 ft. long is

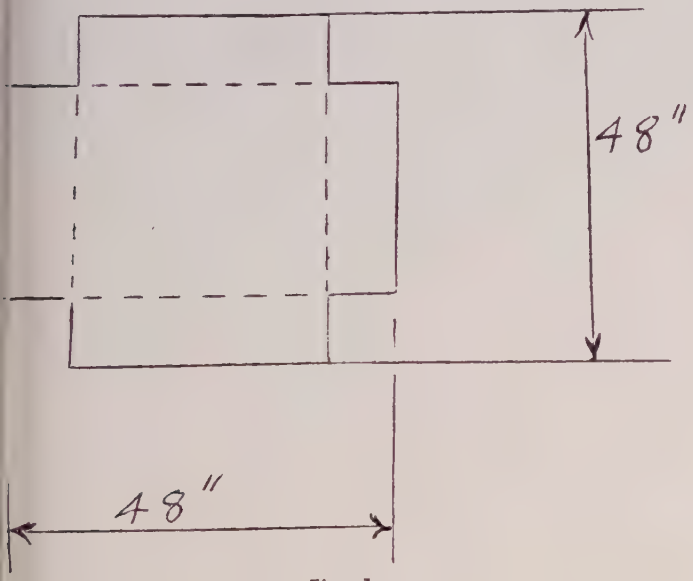


Fig. 1

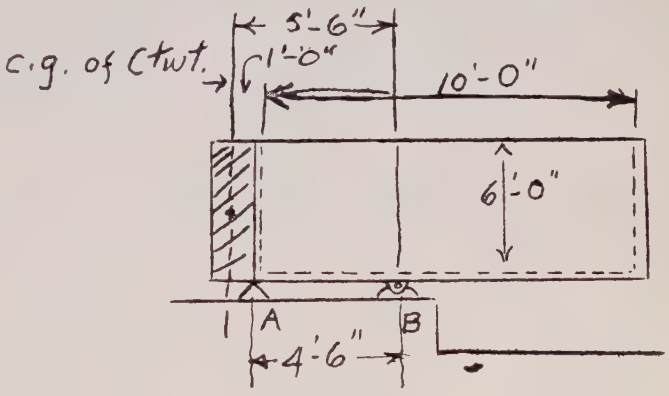


Fig. 4

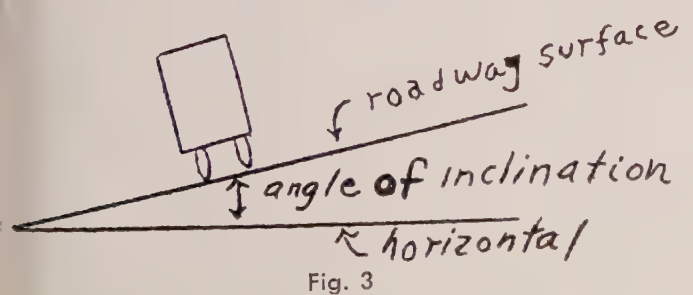


Fig. 3

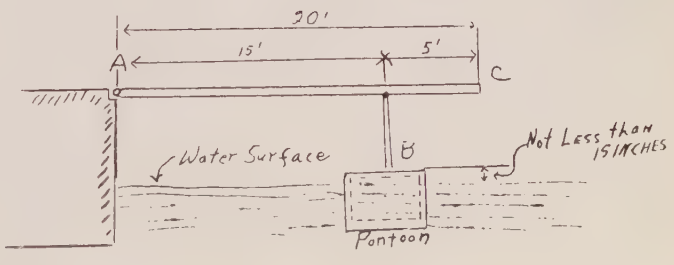


Fig. 5

set between two masonry walls. A strain gage attached to the strut indicates an increase in unit stress of 5,000 lbs./sq. in. under a temperature change of 40° F. Coefficient of expansion is 0.0000065 and modulus of elasticity is 30,000,000 p.s.i. How much did the masonry walls yield under the change in temperature?

* * *

Examination for Registration

PART II

Tuesday, November 19, 1946
1:30 p.m.

Answer eight but no more than eight of the following questions. If more than eight are answered, only the first eight answered will be considered.

Return these question papers with examination book.

1. A portion of the frame of a piece of industrial equipment has the cross section shown in Fig. 6. Due to vertical forces the member may be subjected to a maximum bending moment of +8500 ft.-lbs. and to a maximum shear of 30,000 lbs.
   (a) Calculate the maximum intensity of flexual stress of each sign
   (b) Calculate the maximum intensity of shearing stress. Where does it occur?

2. A hand hoist has a gear train indicated diagrammatically in Fig. 7. The hoist line winds directly onto the drum from the load. The gear and pinion sizes and the diameter of the hoisting drum are as follows:

Pinion A	6 in. dia.
P gear B	24 in. dia.
Pinion C	8 in. dia.
Gear D	48 in. dia.
Hoisting Drum	24 in. dia.

If a workman can maintain a pressure of 40 lbs. on the crank and the friction loss is 10%, what is the capacity of the hoist?

3. A beam is subjected to the loads shown in Fig. 8. What size timber beam will be required if the maximum permissible shearing stress is 120 p.s.i. and the maximum permissible flexual stress is 1500 p.s.i.?

4. A composite post of three pieces of different materials is so constructed and loaded that the three pieces act as a unit and each piece deforms the same amount. The three materials A, B, and C have moduli of elasticity of 30,000,000 p.s.i., 5,000,000, p.s.i. and 18,000,000 p.s.i. respectively, and each piece has a cross section 4 by 8 in. The total load is 1,000,000 lbs.

Calculate the intensity of stress in each piece, and the total load carried by each piece.

5. An open-top, steel-plate water tank has a diameter of 40 ft.-0.0 in. If the joint efficiency is 85% and the maximum permissible intensity of stress in the plate is 18,000 p.s.i., what should be the thickness of plate at a depth of 60 ft.-0.0 in.? Assume water to weigh 62.5 lbs./cu. ft.

6. As used in mechanics of material define:
   Moment of inertia
   Product of inertia
   Principal axes
   Principal moments of inertia about centroidal axes.

7. Calculate the moments of inertia and the product of inertia about the centroidal axes x and y for the section shown in Fig. 9.

8. State how you would locate the principal axes of the section shown in question 7, and how you would calculate the principal moments of inertia.

9. An automobile motor has a cylinder bore of 4 in. and a stroke of 4 in. The connecting rod is 7 in. long. When the crank is 30° down on the power stroke and the pressure in the cylinder is 200 lbs./sq. in., what side thrust is exerted against the cylinder walls?

(Continued on page 16)

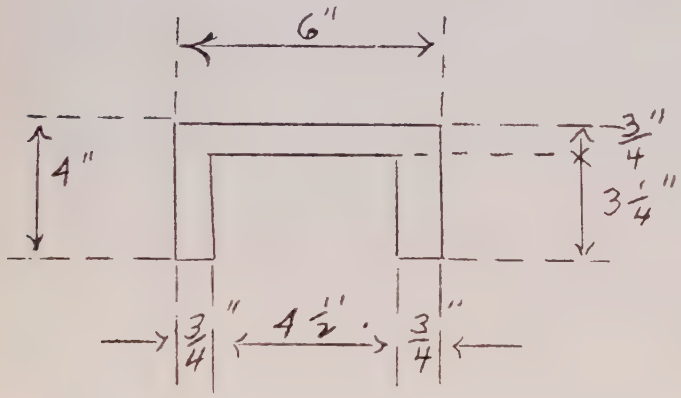


Fig. 6

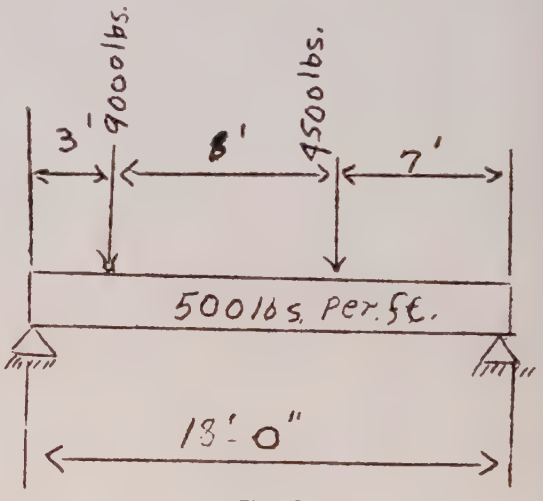


Fig. 8

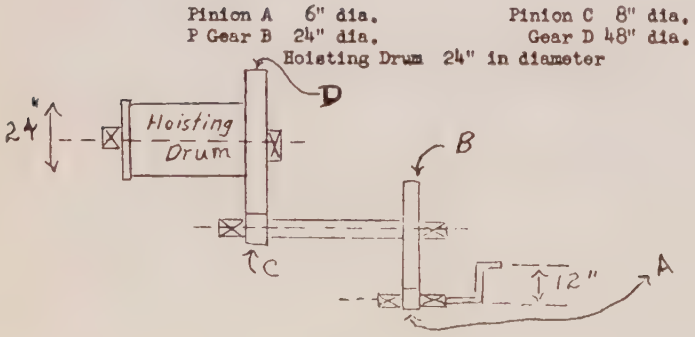


Fig. 7

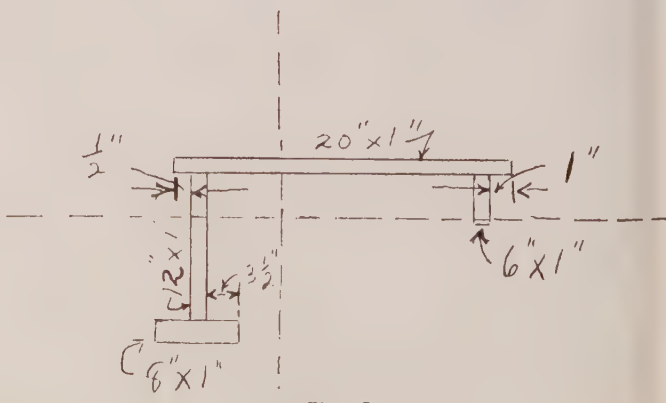


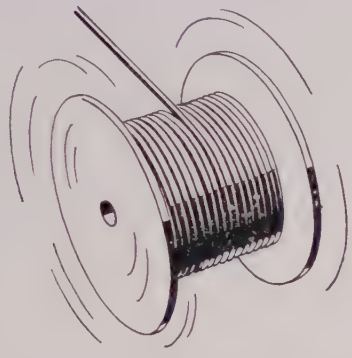
Fig. 9

NUMBER 6 OF A SERIES

Newsworthy Notes for Engineers

What is CV?

CV is the answer to a tough problem. It stands for Continuous Vulcanization—a process developed by Western Electric engineers to speed-up and improve production of rubber-insulated telephone wire. It proved so efficient a process that more than thirty outside manufacturers have introduced CV into *their* plants.



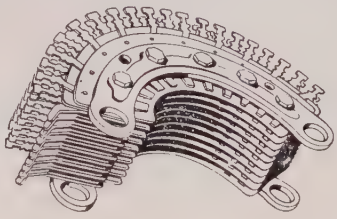
Under previous methods, the rubber compound was fed by hand into a forcing or tubing machine which extruded it upon the wire. The conductor with this unvulcanized covering was coiled in pans in a layer of powdered soapstone and sifted chalk, with each flat coil separated from its neighbor by another layer of soapstone and chalk. The insulated wire in the soapstone and pan was afterwards placed in a steam vulcanizing oven and cured for approximately 45 minutes. An additional reeling or coiling operation was required and the complete process took from one to three hours depending on the insulation wall thickness.

Now the continuous insulating and vulcanizing machine—developed and built by Western Electric engineers—does the whole job in one operation. Rubber compound and bare wire are both fed continuously into one end of the machine and then through steam at high pressure which cures the rubber insulation in approximately 7 seconds. The insulated wire is taken up on reels in continuous lengths up to 30,000 feet in a fraction of the time required under the old panning process.

Halving the steps on Step-by-Step

Simplifying production of over 1,000,000 Step-by-Step "banks" per year—for use in dial telephone exchanges—gave Western Electric engineers an interesting assignment.

One of several types of "banks" consists of 200 brass terminals, assembled in 10 levels, the terminals of each level accurately positioned on a crescent shaped phenol fibre insulator which separates them from the next level. The entire assembly occupies a space of but 4½" x 2½" x 1½". Initially, banks were made in ten steps: (1) spray varnish on phenol fibre strips; (2) punch insulators from these strips; (3) punch *individual* terminals from coils of brass sheet; (4) assemble a preliminary pileup, picking up each terminal by hand,—200,000,000 per year, and accurately positioning it on the varnished insulator; (5) bake; (6) compress to secure terminals to varnished surface of insulators and then dismantle preliminary pileup; (7) make final assembly, inserting additional insulators and spacers; (8) bake; (9) compress and tighten clamping screws; (10) cut off excess length of screws and line ream mounting holes.



Western Electric engineers streamlined these ten steps into five: (1) punch insulators from *unvarnished* phenol fibre strips; (2) punch terminals, leaving them connected to each other, and wind into rolls; (3) automatically separate terminals from roll and eyelet to insulators in punch press equipped with dial feed tools; (4) make final bank assembly; (5) compress and tighten clamping screws.

Results—a 30% reduction in manufacturing cost, an improvement in quality, and more economical utilization of manpower and facilities.

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds — electrical, mechanical, industrial, chemical, metallurgical — who devise and improve machines and processes for large scale production of highest quality communications equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

ENGINEERING EXAM . . .

(Continued from page 14)

10. The pedestal shown in Fig. 10 is subjected to the vertical load and bending moments about the x and y axes as indicated. Assume planar distribution of upward pressure and calculate the intensity of upward pressure at the corners A, B, C, and D.

11. In a test of a centrifugal pump driven by an electric motor the suction pipe is 10 in. in diameter and its gage indicates a partial vacuum of 2.5 ft. of water. The discharge pipe is 5 in. in diameter, is 2 ft. higher than the suction gage and shows a pressure of 50 ft. of water. If the pump is discharging 1.6 cu. ft. of water per sec., and the electrical power input is 12 kw., what is the efficiency indicated?

12. 50hp., 440v., 3-phase induction motor delivers, during the starting period, 150% of normal torque and draws 550% of rated current with rated voltage. The full-load power factor and full-load efficiency of this motor are 80% and 90% respectively. If the starting torque of the load is only 50% of the rated torque of the motor and an auto transformer is used as a starter, what should be the starting voltage to the motor? What is the starting current of the line?

13. A motor-driven pump is required to deliver 400 gal. of water per min. against a head of 200 ft. for 2,000 hours each year. Bids are offered by two concerns for pumps having an expected life of 15 years with a salvage value equal to the cost of removal. The cost of interest, taxes and insurance may be taken as 8% of the purchase price, and the cost of power is 1.7 cents per kw.-hr. Bid A guarantees an overall efficiency of 79% at full load, whereas bid B guarantees an overall efficiency of 75%. How much more is the client justified in paying for the pump and motor with the higher efficiency?

14. Calculate the power required to compress 5,000 cu. ft. of free air, initially at 14.5 p.s.i. and 75° F., to 100 p.s.i., assuming:

(a) Isothermal compression

(b) Adiabatic compression

15. A 1 13-16-in. diameter shaft is supported on bearings 6 ft. apart. A 24-in. pully weighing 50 lbs. is attached at the center of the 6-ft. span. The pulley runs at 400 r.p.m. and delivers 15 hp. to the shaft. The shaft weighs 8.77 lbs./ft. A belt pulls on the pulley with a force of 250 lbs. in a vertically downward direction. Calculate the maximum stress in the shaft due to the combinations of bending and torsional stress.

Examination for Registration

PART III

Groups A and B

Wednesday, November 20, 1946

8:30 a.m.

Answer the question in A. Answer three but no more than three questions from Group B. If more than three from Group B are answered, only the first three answered will be considered.

Return these question papers with your examination book.

GROUP A

1. State in approximately 200 words why you believe you are qualified for registration as a professional engineer in Illinois. Illustrate briefly by describing some engineering project or accomplishment for which you are responsible.

GROUP B

(Answer three questions from this group)

1. Should construction contracts prescribe any or all of the following: (a) define sequence of operation, (b) methods of performing work (c) quality of finished product? Give reasons for your answer.

2. A distributing system of electric energy is supplied by a hydro-electric plant with large pondage for its installed capacity, and a steam plant. The hydro plant can supply about 30% of the total energy used annually.

(a) Taking into account all factors, state how the plants should be operated for economy

(b) Would the operation be the same whether the transmission lines were long or short? Give reasons for your answer

3. A certain section of highway has a +2.5% grade and is 2,000 ft. long. Find the yearly cost of gasoline to operate this grade in the plus direction. The annual traffic up the grade is 500,000 T. It is assumed that grade can be accomplished without shifting gears and the road resistance is 40 lbs./T. Use a gasoline cost of 20 cts./gal. and a motor efficiency of 15 %. There are approximately 5.9 lbs. of gasoline per gal. and each pound of gasoline has an equivalent of 19,000 B.t.u.

Note: There are 778 ft.-lbs. in 1 B.t.u.

4. The timber floor of a bridge requires replacement. Experience has shown that an untreated timber floor costs $3,000, has a life of 10 years and an annual maintenance charge of $500. How much extra will it pay to spend on treatment of the timber if the life of the floor will be increased to 15 years and the annual maintenance charge reduced to $300?

5. A section of the approach to a tunnel will be built below the ground-wate line. Two types of construction are pos sible: (1) a watertight U-shaped struc ture heavy enough to overcome the buoy ancy and strong enough to withstand th upward and lateral pressure of the wa ter. (2) a light structure relieved o the effects of buoyancy by means o drains that lead the water to a sum from which the water is removed b pumping. Outline the method by whic you would determine the more econom ical type of structure.

* * *

Examination for Registration

PART III

Groups C, D, E, and F

Wednesday, November 20, 1946

1:30 p.m.

Answer five questions but not mor than five. If more than five question are answered only the first five answer ed will be considered.

Questions may be taken from one o from two groups but not from mor than two groups. If questions are an swered from more than two groups onl those from the the first two group chosen will be considered.

GROUP C

1. Nitric acid is ordinarily prepare from ammonia by the Ostwald process

(a) Describe the catalyst and give it operating temperature and pres sure.

(b) Give all the reactions involved

(c) What materials of constructio are used in the (1) oxidatio chamber (catalyst housing), (2 nitric acid absorption tower?

(d) The weak nitric acid produce by the process is usually concen trated to a strength of at lea 90% HNO_3. Describe this ope ation and sketch the equipment

2. The reservoir of a municipal, grav ity-fed water-supply system is located mi. from a distribution center in th city, the distributing point being 250 f below the level of the water in the reser voir. A 20-in. inside diameter main han dles 8,000,000 gal. of water per 24 hr If the friction loss in the pipe is 5.0 ft. of water per 1,000 ft. of pipe, wha is the gage pressure in lbs./sq. in. at th distribution center?

3. Nitrogen at 50 lbs./sq. in. abso lute pressure is flowing through a steam jacketed steel pipe at such a rate that is heated from 0° F. to 150° F., usin steam in the jacket at 220° F. If a sim ilar heater were to be constructed t handle the same weight of gas under th same terminal temperature condition but with the diameter of the pipe ha that of the first pipe, what would b

(Continued on page 22)

How do you rate these basic industries

in providing employee benefits, such as paid vacations, pension plans, and so forth?

Which is first? ☐

Railroads __ ☐

Steel _____ ☐

Automobile ☐

Chemical ___ ☐

Oil _____ ☐

Coal _____ ☐

If you made a guess, here's how close to being right you were. Of the six mentioned industries, the oil industry ranks first in formalized pension plans, group life insurance coverage, paid vacations for salaried employees and paid holidays for hourly employees. The industry places second in paid vacations for hourly employees and paid holidays for salaried workers.

The more you know about the oil business, the more you realize that petroleum is one of the progressive industries.

Employee benefit plans have been in force at Standard Oil of Indiana for many years. They are under continuous study with an eye to improving them—and to keeping them well abreast of changing social and economic conditions.

At the start of 1947, our Vacation Plan was again revised. Under the new provisions all 15-year employees will have three weeks' vacation every year, and all 25-year employees will have four weeks—and the vacation policy has undergone several other liberalizing changes. Recently, too, we put into effect a new liberal Group Life Insurance Plan for employees. A new Death Benefits Plan for annuitants will increase considerably the payments made to dependents.

An employee who faces the future with confidence is a loyal and efficient employee. To give our employees that confidence, we endeavor to supply all proper safeguards of an enlightened social economy. At the same time, we provide the incentive of advancement through accomplishment—which is the keystone of the system of free enterprise.

STANDARD OIL COMPANY (INDIANA)
910 SOUTH MICHIGAN AVENUE, CHICAGO 80, ILLINOIS

Featuring Faculty . . .

by Ruth Bone, Chem. '48
and Phil Doll, G.E. '49

PROFESSOR HAY

This month we welcome a newcomer to the engineering faculty, soft-spoken, capable Professor William W. Hay. He takes the position of assistant professor of railway engineering.

Professor Hay's experience in railway engineering is wide and varied, including work on subways and surface railways in the United States and abroad. He has worked with the Pennsylvania railroad, the Milwaukee railroad, the New York subways, and the Reading railroad. Called to active service in the army in October, 1943, he became a company commander in the 744th Railway Operating division. After serving as superintendent of maintenance of ways with the 710th Railway Grand division in Western Europe, Professor Hay was transferred to Korea, where he aided the American military government by rejuvenating the neglected Korean railways as chief engineer, both of the bureau of transportation and of the Korean railways.

Born in Bay City, Michigan, Professor Hay attended Carnegie Tech in Pittsburgh and graduated with a B.S. in management engineering. He has done graduate work at Yale university and New York university.

A member of the American Railway Engineering association, Professor Hay also belongs to the Army Transportation association and holds a lieutenant-colonel's commission in the reserves. Photography, canoeing, and of course, the inevitable railroads, are included in his hobbies. Throughout the war he carried a Kodak Bantam with which he snapped many pictures of foreign railways.

HARRY HORN

"What do you want to interview me for? I'm not dead yet," were the opening words of Harry Horn, associate professor of electrical engineering. Mr. Horn is a tall, slender, and modest man with an obviously subtle sense of humor.

He was born in Cleveland, Ohio, had his high school training at East High in Wichita, Kansas, and then went to the University of Kansas. Although he is an electrical engineer now, he was once an English instructor. He received an A.B. in English at the University of Kansas where he did some graduate work and, at the same time, taught American Literature and a graduate course. Doing a complete about face, his interest suddenly shifted from literature to engineering whereupon he came to the University of Illinois to receive his B.S. degree in electrical engineering. He then went to M.I.T. to earn his master's.

He came back to the University as an instructor in the fall of 1937 and stayed until he went into the navy in

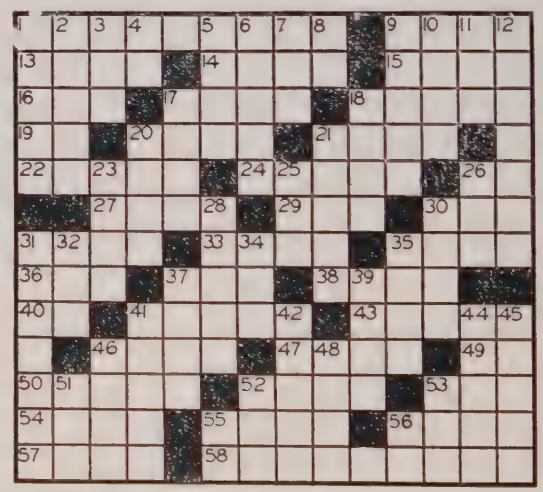
PROFESSOR HORN

June of 1944. He went into officer training and then into radar training. Professor Horn had his pre-radar training at Bowdoin college, Maine. He was assigned to the post-graduate school at the naval academy where he instructed fleet officers in electrical engineering. He remained there until the spring of 1946 when he was released from service with the rank of lieutenant. He then returned to the U. of I. as an instructor.

Professor Horn, a member of the I

(Continued on page 36)

Crossword Puzzle



ACROSS

1. Italian scientist who improved electric generators
9. Attract, like a magnet
13. Very soon
14. Turf cut for fuel
15. Wealthy
16. The present time
17. Form in a mold
18. —— not, want not
19. Reporter's boss: colloq.
20. Unit of an electric battery
21. Microphone: slang
22. Sour fruit
24. Cognizant
25. Chlorine: chem. symbol
27. Fragments
29. Piece out
30. Appropriate
31. George S. Claude made this famous
33. District in Portuguese East Africa
35. Adult fawn
36. Sea eagle
37. Chop off
38. Track
40. More than just me
41. Drop
43. Equals
44. Part of a shoe
47. Invented the elevator with brake
49. Near
50. Electrical multiplier
52. Large South American snakes
53. Feminine name
54. Leave out
55. Important farm building
56. Ancient Greek contest
57. Bolt fasteners
58. Inventor of bakelite

DOWN

1. Front of a radio containing dial, etc.
2. Positive electrode
3. Adult heifer
4. At home
5. Iridescent gem
6. Inventor of the induction motor
7. Exchange for a tit
8. The thing
9. Famous English navigator
10. Advance in price
11. Deed
12. Inventor of the electric fan
17. Coin
18. Telegram: colloq.
20. Maize
21. Manufacturer
23. Lovers' favorite source of light
25. Form of electric cell
26. Billiard stick
28. Inventor of a tuning-in connection for wireless
30. Take out: proofreading
31. Proton and electron in close union
32. Bitter vetch
34. Finial on a spire
35. Forms for stamping metal, etc.
37. Easter flower
39. Sacred bull of Ancient Egypt
41. Ditches protecting castles
42. Inventor of a vacuum-type lamp
44. Radium emanation
45. Remain erect
46. Gash
48. Moving fortress
51. Large Australian bird
52. Cry of sheep
53. Turkish military title
55. Size of shot
56. Major league in baseball: abbr.

Du Pont Digest

Items of Interest to Students of Science and Engineering

The Synthesis of Nylon

Chemists of original nylon research team honor memory of Dr. Carothers at the dedication. They are: J. W. Hill, Ph. D., M. I. T. '28; H. B. Dykstra, Ph. D. Ohio State '27; G. J. Berchet, Ph. D. Colorado '29; J. E, Kirby, Ph. D. Iowa State '29; E. W. Spanagel, Ph. D. McGill '33; D. D. Coffman, Ph. D. Illinois '30; and F. J. Van Natta, Ph. D. Michigan '28. Dr. Carothers received his Ph. D. from Illinois in 1924.

Dr. Wallace Hume Carothers

1896-1937, was the first organic chemist in industry to be elected to the National Academy of Sciences. During his short scientific career he made contributions that have greatly enriched American life.

Recently the Nylon Research Laboratory near Wilmington was dedicated as "The Carothers Research Laboratory," in honor of the late Wallace Hume Carothers and his classical researches on the structure of polymers, the mechanism of polymerization, and the invention of nylon.

In 1928, a group of chemists under Carothers began a study of polycondensation which led eventually to the discovery of nylon. The project was part of a program of fundamental research to discover scientific facts which might be of eventual value in laying a foundation for applied research.

As the first point of attack, they chose the condensation of dibasic acids with glycols and reaction materials which would preclude the formation of rings. They obtained linear polymers of molecular weights between 2300 and 5000.

Molecular Weights Increased

After two years, a significant advance in linear polymer preparation was achieved. Through the use of the molecular still, it was possible to obtain materials of molecular weights between 10,000 and 25,000, which, when molten, could be drawn into filaments.

More important, the cooled superpolyester filaments could be further drawn into fibers several times their original length and thereby acquired luster, tensile strength, elasticity, pliability, and toughness much greater than the initial polymer. In contrast with ordinary textile fibers, their tensile strength was unchanged by wetting.

The striking properties of the fibers aroused the hope of finding a commercial fiber from some type of linear superpolymer. Investigation showed, however, that fibers from the polyesters were too-low melting and too soluble for textile purposes. Mixed polyester-polyamides were also not of interest in this category.

Research on Fibers

The possibility of a commercial fiber development seemed remote, but the intuition that frequently accompanies research genius prevailed, and Carothers was encouraged to direct his research on superpolymers specifically toward spinnable fibers. A polyamide from 9-aminonanoic acid gave a fiber of 195°C. melting point, equal in strength to silk, and clearly indicated the possibility of obtaining a material for fibers of commercial utility.

In 1935, the superpolymer from hexamethylene diamine and adipic acid was first synthesized. It melted at 263°C., was insoluble in common solvents, tough, elastic and had the best balance of properties and manufacturing costs of any of the polyamides then known.

A third period of research covered commercial development. The task was enormous, and to reduce to a minimum the "time between the test tube and the counter" a large force of some of the most competent chemists, physicists, chemical and mechanical engineers available was assigned to the project. The story of the manufacture of nylon will be told next month.

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ARTHUR LEININGER
Editor

•

GEORGE FOSTER
Associate Editor

Illinois Technograph

Shortly before the war a great many people could frequently be heard to say, "I sure do wish that we could get back to the good, old 'horse and buggy' days!" Even today the same idea is often expressed when one man turns to his neighbor with, "Well, now that the war is over I guess it will take a little while for things to return to normal, but I certainly wish it would hurry up."

The mere expression of the idea indicates that many people recognize the fact that something important is lacking in our lives today. Most people, however, do not go beyond the point of complaining about it. Like the weather, it's something they feel they can't do anything about anyway—so why try. Fortunately for all of us, something can be done about it provided we know what IT is.

In other words, what was there about life in the 'horse and buggy' days that seems to be desirable to us now? Was it the low prices and wages characteristic of the relatively stable economy of the early nineteen hundreds? Was it the independent feeling caused by the greater number of small businesses at that time? Or was it the slow, easy-going pace of living also so characteristic of that era?

Even just a little thought on the subject should reveal the fact that none of these things, either individually or collectively, are sufficiently important to make a return to the 'horse and buggy' days so desirable. A little more serious thought on the subject, however, should reveal that the one thing, above all others, which made living at that time so much more pleasant than now is that the average individual then exercised a little CONSIDERATION FOR THE RIGHTS OF THE OTHER FELLOW!

Consciously or carelessly, the average person today seems to have forgotten all about such a thing as the Golden Rule. In this age of high-speed living, economic insecurity, excessive wage and price demands, and general, all-around upheaval the average individual has become hyper-intent on making money and promoting his own interests. Consequently, this "every-man-for-himself" attitude has virtually made the average person apparently totally unaware of the fact that someone else is trying to live in this world besides himself.

The truth of this statement is readily evident, and examples of thoughtless selfishness can be found today in almost any corner of life. How often, for example, have you walked into a crowded restaurant, where the waiting line forms to the rear, and seen people discussing the weather over their second or third cup of coffee, blissfully ignorant of the fact that anyone else is within a thousand miles. When you are patiently waiting your turn in a line, how many times have you seen that fellow walking down from the head of the line and searching hopefully for a friend? How did you feel that time when some fellows, chatting merrily away, were walking four abreast along the sidewalk and you either had to get off in the snow or go charging right through them? Or how frequently have you been driving along the street and that fellow up ahead veers to the left, cuts rights across in front of you, and then wants to know why in h— you can't look where you're going? On the other hand, how many times have YOU been that fellow?

These are only a very few of the classic examples of the thoughtless lack of CONSIDERATION FOR THE RIGHTS OF THE OTHER FELLOW. The entire list would require too much space and would consist largely of minor infractions like the ones mentioned. When it comes to a real crisis, the average individual will respond selflessly because he takes the time to think; but in every-day living he goes thoughtlessly about his business, irritating the people with whom he must associate simply because he "just didn't think." This egocentric attitude may be fostered partly by the economic conditions and partly by the traditionally American theory of individual independence; but in order to live pleasantly—yes, even peacefully—with our fellow man, greater recognition must be given to the social interdependence of people. We cannot even hope to establish successful international relations through the United Nations unless we first learn to live with each other.

To do this, you and I must work into our daily lives much greater THOUGHTFULNESS FOR THE RIGHTS OF THE OTHER FELLOW. Although seemingly a bit difficult, this can be accomplished very simply by two, quick rules-of-thumb: (1) Is this action of mine going to interfere with or irritate anyone, and (2) How would I feel if someone else were going to do this and I were on the receiving end.

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ENGINEERING EXAM . . .

(Continued from page 16)

the percentage change in length of the pipe?

4. A boiler is fired with a coal containing 75% carbon and 8% ash, burned under such conditions that the elimination of combustible matter from the refuse is complete. The air enters the furnace at 90° F. with a relative humidity of 80%. The vapor pressure of water at 90° F. is 36 mm. of mercury. The flue gases go to the stack at 680° F., the average flue-gas analysis show 12.6% CO_2, 6.2 % O_2, and 1% CO. Calculate:

(a) The per cent of excess air
(b) The complete analysis of the fuel
(c) The cubic feet of stack gas per pound of coal
(d) The cubic feet of air per pound of coal

5. For a by-product coke plant:

(a) Draw a sketch of a by-product coke oven and label the principal parts
(b) Describe how ammonia is recovered from the gas
(c) Describe a method for removing hydrogen sulfide from the gas other than by the use of lime and iron oxide
(d) Describe the recovery of benzene from the gas

6. As an engineer, you are asked to design the evaporating system to concentrate 50,000 lbs. per day of caustic solutions from 8% to 50%. Briefly outline the procedure to be followed, including the data required, the method of determining the best set-up and materials of construction.

7. In a certain process there is recovered a mixture containing about 10 molar % of normal propyl alcohol and about 90 molar % of water. It is proposed to prepare from this, by one or more continuous distillation operations, a recovered propyl alcohol containing at least 98 molar % of propanol (with not more than a trace of benzene) and a waste carrying not more than 0.1 molar % of propanol and not more than a trace of benzene. Benzene is to be used as the "azeotropic" separating liquid.

Data are:

	B. Pt.-°C.
Water	100
n-Propanol	97.2
Benzene	80.2

Azeotropic mixtures:

Molar per cent in Vapor			
Water	Benzene	Propanol	B. Pt.-°
56.83	0	43.17	87.7
0	79.1	20.9	77.1
29.6	70.4	0.0	69.2
28.3	62.8	8.9	65.8

Draw a neat flow sheet for a dis lation plant to effect the desired sep ation, indicating the approximate co position of each stream entering a leaving each column. If the reflux the top of a column differs in compo tion from the product withdrawn at t top of that column, indicate the appro imate composition of each.

8. A ball mill fed with ¼-in. ro is delivering a ground product for so tion in a leaching tank. The produ must not be coarser than 20-mesh; t presence of material much finer than 2 mesh is not advantageous. The ball m is operating in closed circuit with a cl sifier that removes the 20-mesh mater and returns the oversize to the mill.

A screen analysis of the mill outflo shows an undesirably large percenta of material of about the feed size slightly below it; the percentage of m terial in the range from 6-mesh to 2

(Continued on page 30)

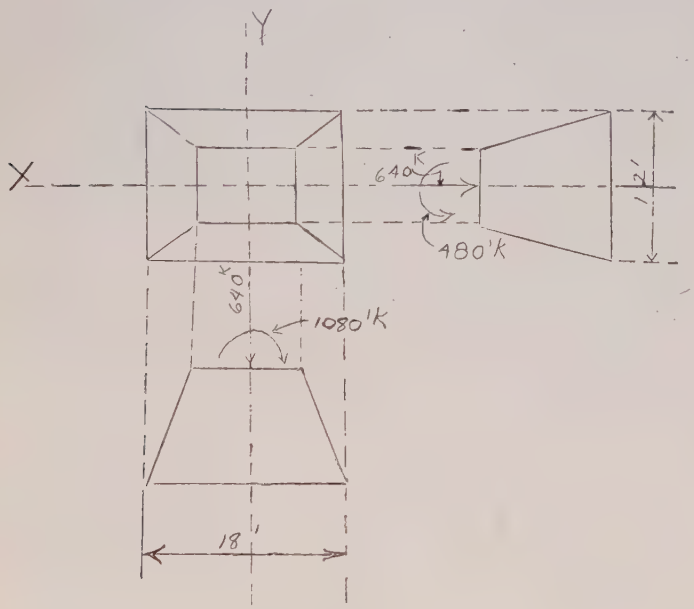

Fig. 10

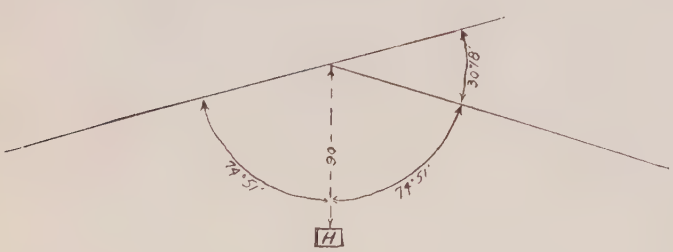

Fig. 11

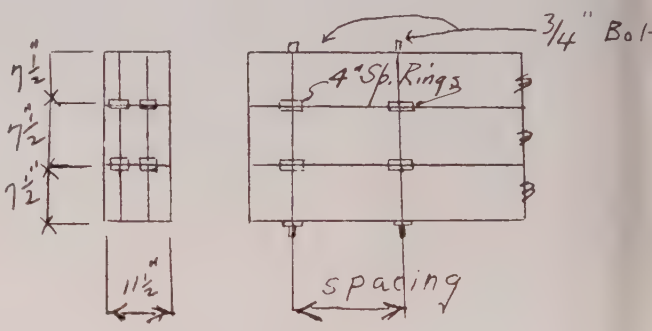

Fig. 12

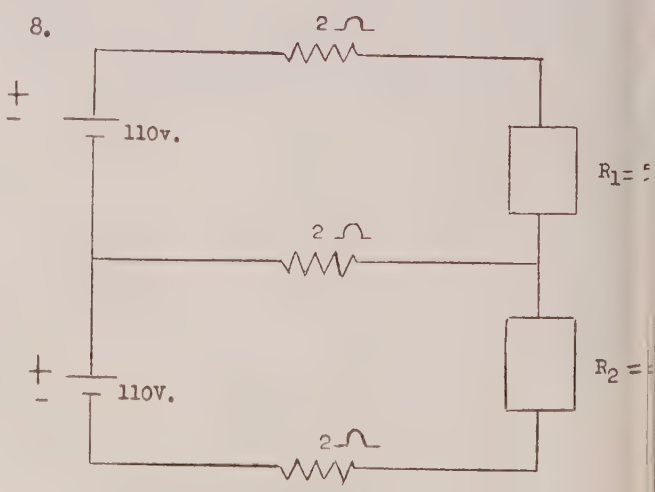

Fig. 13

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What Electives Shall I Take?

by Ed Witort, E.E. '49

The wise selection of electives should be the concern of all student engineers because electives are an integral part of every engineering curriculum. Electives are included in the curriculum for an express purpose: To offer the student opportunity for as broad a training for industry and society as is possible in the time available. To satisfy this requirement, an elective should fulfill one of two conditions: (1) It should parallel your major field. For engineers, additional mathematics, physics, and chemistry courses are recommended. A few non-technical courses may also be included in this category, among them public speaking and business letter writing, both of which are indispensible to the graduate engineer. (2) It should train you to be an intelligent and rational member of your community. This group includes all the humanities—political science, history, economics, etc. A large number of students have hobbies, and would find it advantageous to further their knowledge along this line. In this instance it would be advisable to ultilize their electives to assist them in the attainment of this knowledge. Consideration would then be given to the natural sciences, such as botony and zoology, and courses in radio, photography, etc.

The paucity of electives in our engineering curriculum makes it desirable to consider various other factors before making the final selection of an elective. The contents of some courses are easily grasped and therefore can be mastered after graduation by home study. However, other courses, such as zoology and botany, require expensive equipment and it would be impractical to attempt to study these subjects if the equipment is to be purchased at one's own expense. Other courses require constant guidance; namely, mathematics and physics where progress might be erratic when attempts are made to master them without an instructor; while still others require constructive criticism, such as public speaking and letter writing. Electives requiring one of the above factors, namely, equipment, guidance, or criticism, should be given first consideration by the student.

The time available for formal courses is limited; however, formal courses are not the only source of information available to the student engineer. Valuable experience can be acquired by participation in extracurricular activities. There are many departmental societies on campus whose aim should be to encourage activities that are non-technical. Other opportunities include the meetings of the technical and non-technical societies and attendance at lectures given by speakers brought to the campus by these societies.

Engineering is analysis and reasoning. Engineering methods can be applied in the selection of electives.

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ELECTRICAL RESEARCH . . .

(Continued from page 7)

sive experience in the planning, direction and coordination of research in his previous position as chief engineer of Special Projects laboratory at Wright field.

Since the outset, association with branches of the armed services and with industrial concerns has been actively sought, with the result that the program now includes projects for the Army Air forces, the Signal corps, and the Office of Naval research. Provision is being made to enlarge the participation of industrial concerns in sponsorship of research programs and research fellowships. Plans are likewise in action to provide a nucleus of fundamental research sponsored only by the University and subject to no limitations as to subject matter or eventual direction.

The research and development problems arising from the necessities of World War II are very much in evidence in the programs now being followed. For example, the largest single group, under the direction of Prof. A. L. Samuel, is engaged in the development of high frequency klystrons and magnetrons for low-power receiver tube work. The need for local oscillator tubes in radar receiving sets still exists although the emphasis has shifted to higher and higher frequencies. In connection with these tube development researches, investigation is being conducted into new methods of generating ultra-high frequency, continuous waves ranging in frequency up towards an eventual union with the infra-red spectrum. Plans have been drawn up for a completely modern tube laboratory which offers the latest facilities and techniques in tube construction and design. The University has set aside $50,000 for the modernization of the large lecture hall, room 215 E. E. laboratory, for this purpose. At the present writing, construction work is being started.

Problems of power measurement at ultra-high frequencies and the specification of crystal oscillator circuit constants are being carried out by groups working with Dr. L. T. DeVore, who divides his time between general administration of the whole program and specific research problems on theory and techniques of measurement.

A novel approach to the study of arc welding techniques is offered by a group working with Dr. G. H. Fett on the high-speed photographing of the deposition processes active in welding arcs. From these studies it is hoped to dis cover the mechanisms by which meta is transferred from the welding elec trode to the welded joint. By way o contrast, another group is working o a problem in the electrical measuremen of very small time intervals; in particu lar, an application to radar range deter mination is of immediate significance Any improvements in this field are o great importance and interest to th scientist in general.

While these projects indicate to som extent the scope of the research pro gram, they are by no means exhaustive of the list. Problems in the detection o infra-red radiation are being considered by workers with Dr. F. D. Bennett and Mr. W. J. Fry. Fundamental studies i electromagnetic field problems, of imme diate importance in direction findin techniques, are being made by a grou under Dr. E. C. Jordan. The effect o wave form and frequency on power ma chinery design is a project about to b initiated by Professors Keener and Fau cett. Problems in illumination engineer ing can be studied under Prof. J. O Kraehenbuehl.

Opportunities for graduate research in the above programs are numerous There is a steadily growing list of re

(Continued on page 29)

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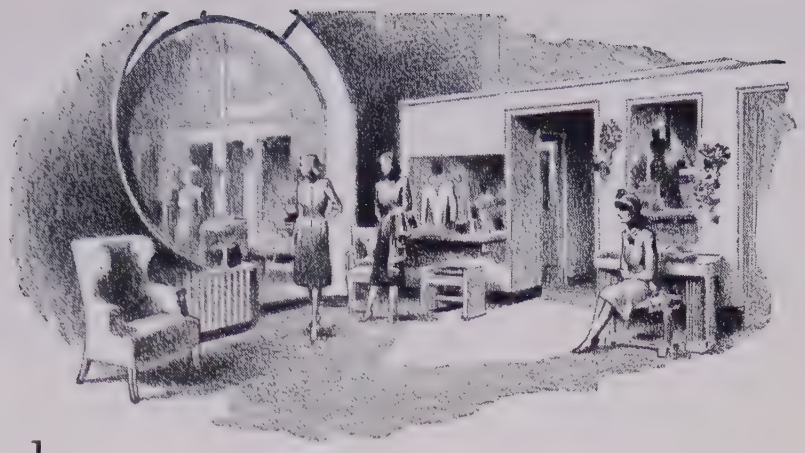

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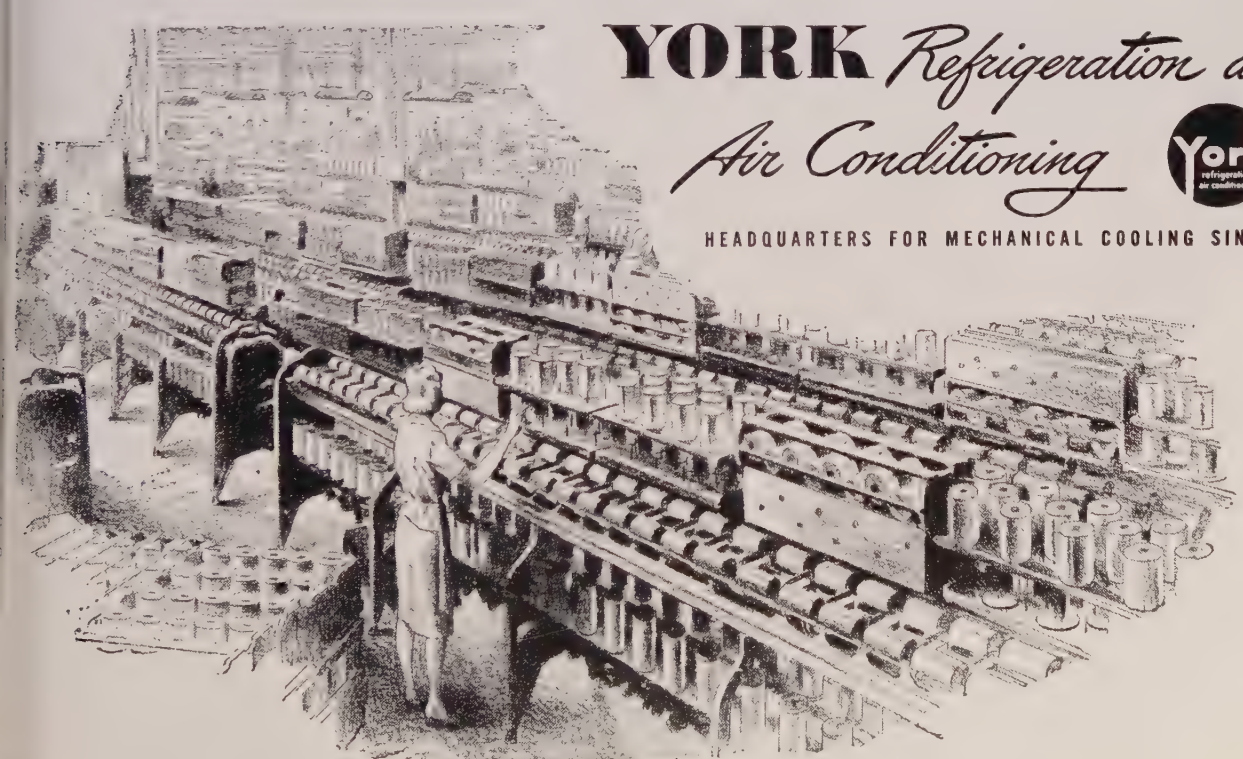

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ECTRICAL RESEARCH . . .

(Continued from page 26)

rch assistantships and fellowships ilable. At present, there are more n one hundred students enrolled in duate electrical engineering study, inding a group of forty officers sent the Signal corps, Army Air forces, l Army Ground forces to obtain prepction in advanced subects.

While, at present, the great expanon of both graduate and undergraduate nches of the department has imposed ere restriction on the space available research work, construction of the w electrical engineering building, to located on the site of the present ilth center at the corner of Green l Wright streets, will enable more equate housing for the work of the ire department.

Trends along which the research proams will develop in the future point ward increased cooperation with other partments in the University, and tords increasing contact with industry the solution of basic problems of mul interest. At present, efforts are ng made to establish a cooperative ogram with the mathematics departnt for research into the design of ctrical and mechanical calculating chines. The notable progress made at ner centers during the war merely ves to emphasize the great need for id automatic calculating devices to reve research workers of much of the por involved in correlating and analyzg data. In the field of industrial coeration, a project is now being card out with the Eli Lilly company for e development of acoustic-field generas for use in research on biological stems. Extension into other fields of is type of cooperation are actively ught at the present time.

Down Like a Feather

A new electric control system for wering cargo to docks can bring a e-ton load to a jarless stop from a op of 150 feet a minute.

Near-Perfection Rejected

Tungsten filaments 99 and 44/100 r cent pure are rejected in the manucture of light bulbs. The rating must at least 99 and 99/100 per cent.

Safe Nursery Temperatures

For the winter nursery at night, open e window slightly at the top and place ur electric fan on some high cupboard shelf, then adjust it for medium speed circulate the air gently. This will sure even sleeping temperatures and ixing of warm and cool air without anger of drafts.

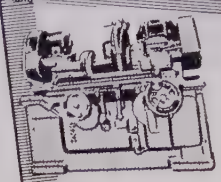
Here's What NORTON Makes . . .

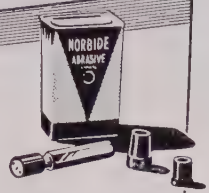
ABRASIVE PRODUCTS

Grinding wheels ranging from tiny internals 3/16" x 3/16" to gigantic ten-ton pulpstones — wheels of Alundum*, Crystolon* and diamond abrasives, of many different bonds; abrasive bricks, sticks, hones and segments; mounted points and mounted wheels; abrasive grain for polishing, lapping and tumbling.

GRINDING and LAPPING MACHINES

Norton cylindrical grinders range from the neat, compact 4 x 12" Type C to the gigantic 36 x 816" Type D and include special types for grinding crankshafts, camshafts, rolls and car wheels. Norton surface grinders are available in three sizes, 6", 10", and 12". There are three Norton Tool and Cutter Grinders and the Norton Buraway. Lapping machines for flat and cylindrical work including crankshafts and camshafts range from the small 10-U to the large Hyprolap*.



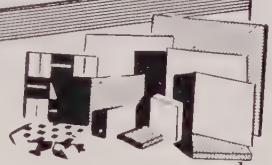


NORBIDE*

"The hardest material made by man for commercial use"— that is NORBIDE*, the trade name for Norton Boron Carbide. It is serving industry in three forms: (1) Norbide Abrasive for grinding and lapping carbide tools, and for lapidary work; (2) Norbide Molded Shapes for pressure blast nozzles and for plug, ring and other types of gages; (3) Norbide Metallurgical Compound for improving the hardness and cutting ability of tool steels and as a deoxidizing agent.

REFRACTORIES

The terrific heat of the electric furnaces which produce Alundum and Crystolon abrasives also gives these materials valuable refractory properties — properties which are made use of in a complete line of Norton refractory grain, cements, bricks, plates, tiles and other shapes for metal melting and heat treating, for enameling furnaces, ceramic kilns, boiler furnaces; also refractory laboratory ware for ignition, incineration and filtration.



NORTON FLOORS

The hardness, toughness and abrasive properties of Alundum abrasive are made use of in NORTON FLOORS — Alundum Stair and Floor Tile, Alundum Ceramic Mosaic Tile and Alundum Aggregate for terrazzo and cement floors. They are for use in public and commercial buildings to provide an extremely wear-resisting and permanently non-slip surface (wet or dry) for floors and stairs.

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Sharpening stones in sizes and shapes to meet every need of the industrial worker, the farmer and the home craftsman; and abrasive paper and cloth in a wide variety of coatings and types for both industry and the home mechanic are available through Behr-Manning Corp., Troy, New York, Division of Norton Company.

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Informative literature on any or all Norton products gladly sent on request—no obligation.

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NORTON

ENGINEERING EXAM . . .

(Continued from page 22)

mesh is low; a rather large part of the fraction that passes the 20-mesh sieve also passes the 100-mesh sieve. The mill is operating at about optimum speed. The crusher feeding the mill cannot conveniently be set to deliver a product finer than ¼ in.

What change in loading operations would you suggest to increase the productivity of the mill, in tons of material that would pass a 200-mesh screen?

GROUP D

1. (a) You are to decide the length of span over a creek with the following information: The drainage area is 25,000 acres consisting of heavily wooded area and subject during spring to great amount of ice flow. Use Talbot's Formula with a coefficient of 0.8. The highest water known was 15.9 ft. above flow line of stream.

(b) How many spans would you recommend and why?

2. Given: Two tangents on centerline of survey intersecting at an angle of 30°-18′. A house is 90 ft. from the point of intersection exactly in the center of the interior angle. Compute to the nearest minute the degree of curve necessary to run in a curve so that the distance from centerline of curve to the house will be 38 ft. (See Fig. 11).

3. It is desired to pump water at the rate of 100 g.p.m. from a storage reservoir to an elevated tank with an electric motor driven pump.

Given:

Elevation of water in reservoir — 35.0 ft.
Elevation of pump—43.0 ft.
Elevation of water in elevated tank —143.0 ft.
Pump efficiency—60%
Motor efficience—89%
Cost of current—3c per k.w.h.
Friction loss in piping—12.0 ft. head loss.

Find:

(a) Total dynamic head
(b) Brake horsepower required
(c) Cost of pumping 36,000 gal.

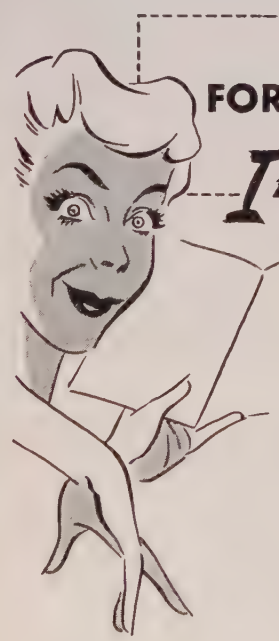
4. Concrete Structures and Pavements:

(a) What are the approximate volumetric proportions of cement, fine aggregate and coarse aggregate used in making concrete?
(b) What is the approximate minimum mixing time in making concrete in a mixer?
(c) Name at least one approved method of proportioning
(d) Name at least two methods commonly used to cure concret pavements
(e) What is the allowable toleranc in surface of a concrete pave ment when tested with a 10-f straight edge?
(f) What is the approximate mini mum required compressiv strength in lbs./sq. in. of con crete at age of 14 days?
(g) What type of equipment is gen erally required to compact an consolidate concrete, which ca be used both in structure an pavements?

5. Earth Excavation and Embank ment:

(a) What percentage of compactio is usually used as a "rule o thumb" method to roughly figur the amount of excavation requir ed to construct a fill of known size?
(b) Name the minimum equipmen required for highway grading in volving 100,000 cu. yds. in thre miles of work in which the haul are not over 1,500 ft.
(c) How are fills compacted behin bridge abutments? Would yo recommend water soaking? Giv reasons.

(Continued on page 32)



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We blew a bubble for a man named Edison . . .

SIXTY-EIGHT years ago a stranger got off the train at Corning, New York, and asked the station agent to direct him to Corning Glass Works.

He had been sent by Thomas A. Edison to see if Corning could succeed where others had failed, in making a glass bulb to surround the filament of his new electric lamp.

Producing the thin bubble of glass for Mr. Edison's first lamp was an early milestone in Corning research. If he had lived until his hundredth anniversary this year, Edison would see machines developed by Corning turning out hundreds of modern bulbs every minute.

Altogether Corning has contributed in countless ways to science and industry and the comfort of living. Casting the 200 inch telescope disc, which this year will bring our civilization a billion "light years" closer to the secrets of the universe, is a Corning achievment.

So are the colored signals that guide trains through the night in safety. So are the miles and miles of America's neon tubing, and the miles of acid resisting glass piping in food and chemical plants. So are gleaming Pyrex baking dishes and amazing Pyrex Flameware for top-of-stove cooking.

The very thermometer the doctor puts in your mouth is quite likely made of Corning tubing. Today Corning research's main task is helping manufacturers make better products at lower cost. After graduation, this research may help you get ahead faster. Write the name Corning in your memory book now and call on us when you need help. Corning Glass Works, Corning, N.Y.

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Research in Glass

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American Zinc Institute

Room 2618 —35 East Wacker Drive, Chicago 1, Illinois

ENGINEERING EXAM . . .

(Continued from page 30)

(d) What type of materials would you recommend for back filling a bridge abutment if it was desired to be immediately paved?

(e) How is a fill constructed adjacent to the abutments of a slab bridge? Explain.

6. You are retained to design a sanitary sewer system and sewage treatment works (secondary treatment) for a residential municipality of 10,000 population including an institution of 500-person capacity.

(a) Detail the minimum design factors to be used for the sewer system and the several units of the treatment works to conform to the usual standards of the profession

(b) Substantiate the type of sewage treatment selected

7. You are retained by a municipality to prepare a report for a water treatment and softening plant for its existing water supply.

Describe in detail what investigation you would make to permit preparation of a comprehensive report and salient points to be covered in such reports.

8. A built-up beam simply supported and composed of three 8-in.x12-in. (7½ in. x11½ in. finished size) Douglas fir timbers, as shown in Fig. 12, is to be designed to carry a live load of 1,200 lbs. per lineal ft. on a 26-ft. span. The timbers are to be jointed together with 4 in. split ring connectors in pairs and ¾ in. dia. bolts. Assume that the connector safe load is 11,000 lbs. per pair and that the allowable maximum horizontal shearing stress in 100 lbs./sq. in.

Find:

(a) Maximum horizontal shearing stress.

(b) Horizontal shearing stress adjacent to support on plane of joints between timbers

(c) Spacing of connectors adjacent to support.

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GROUP E

1. A 50-mi. transmission line is to be constructed to interconnect two power systems, and is to carry approximately 50,000 kw. The station bus of system A operates at 13.2 kv. while that of system B operates at 24 kv. OUTLINE the principal consideration affecting:
   (a) choice of voltage
   (b) the mechanical design of the transmission line
   (c) the electrical design of the transmission line including lightning protection and any other factors affecting reliability or service continuity
   (d) relay protection of the line and terminal equipment
   (e) control of power flow over the tie line

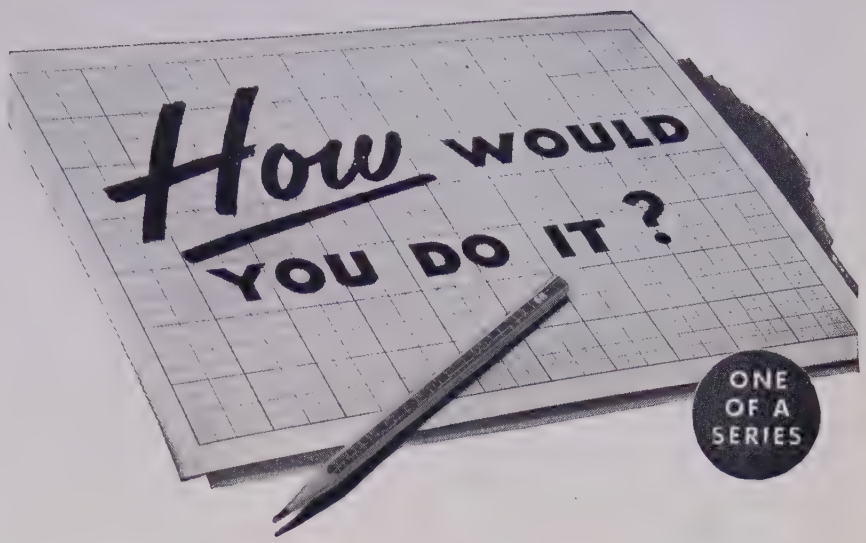
2. Define any ten of the following terms:

1. Inductance	9. Stability (of a machine or line)
2. Reactance	10. Skin Effect
3. Capacitance	11. Hysteresis loss
4. Power	12. Dielectric loss
5. Power Factor	13. Corona loss
6. Harmonics	14. Transient (electrical)
7. Resonance	
8. Regulation (electrical)	

3. (a) Explain the importance of insulation in electrical engineering
   (b) What is meant by Class A and Class B insulation?
   (c) Define dielectric constant, power factor and dielectric strength of insulation and give order of magnitude of these quantities for commonly used gas, liquid, solid organic and ceramic materials. What instruments and electrical circuits would you use to measure them?
   (e) Define surface leakage of insulators. What material or treatment has been recently devised to reduce it?
   (f) What is "tracking" caused by insulation flashover?
   (g) Name as many commonly used insulating materials as you can, state where they are used and why they are selected for these applications

4. The following data applies to a stage of resistance coupled audio amplifier:
   Tube amplification factor: 20
   Plate resistance: 0.01 meg.
   Plate supply: 250 v.
   Grid bias: —3 v.
   D.c. plate current: 3 ma.
   Plate load resistor: 0.05 meg.
   Grid resistors: 1 meg.
   Coupling capacitors: 0.01 mfd.
   Grid voltage for zero current: 12 v.
   (a) What is the d.c. voltage at the plate of the tube?

(Continued on next page)



PROBLEM — You are designing an automobile service car with a crane on the back end. You are going to take power from the transmission to drive the crane drum. How would you do it?

THE SIMPLE SOLUTION — Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other end to the clutch which operates the crane drum—simple, easy to install, good for positive, dependable operation.

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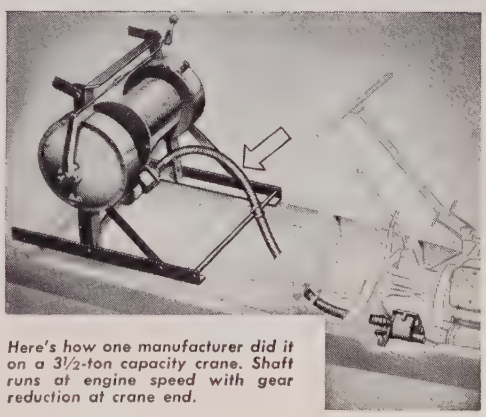
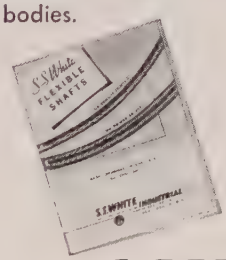
This is just one of hundreds of remote control and power drive problems to which S.S.White flexible shafts provide a simple answer. Engineers will find it helpful to be familiar with the range and scope of these useful "Metal Muscles"* for mechanical bodies.



Here's how one manufacturer did it on a 3½-ton capacity crane. Shaft runs at engine speed with gear reduction at crane end.



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ENGINEERING EXAM . . .

(Continued from previous page)

(b) What is the plate dissipation of the tube?

(c) What is the maximum r.m.s. value of the input signal to the grid that may be handled under Class A1 operating conditions?

5. A telephone cable has an attenuation of 1 db. per mi. at 800 cycles and a characteristic impedance of 500 ohms. A repeater is placed in the middle of 50 miles of the cable. The cable is required to supply 10 mw. into a 500-ohm resistor at the receiving end and the repeater has a power gain (power output/power input) of 10,000. What must the input to the line be? What voltage must be impressed at the sending end of the line?

6. (a) In a shunt wound motor the applied voltage is 220 v. and the back e.m.f. is 210 v. The resistance of the armature is 0.2 ohms and that of the field 70 ohms. If the iron and copper losses in

(b) A d.c. motor under test gave the following results:

Voltage 460 v.
Current 33 amps.
Effective load on brake 210 lbs.
Diameter of pulley 13 in.
R.P.M. 785.

Find the brake horsepower and efficiency

7. Fill in each blank column below with the proper words selected from the answer group above that particular column—using each possible answer at least once.

Yes
No

Hot
Cold
Pool

Ignitor
None
Electro-static
Electro-magnetic

Welding control
Intermediate frequency amplifier
Television
Register controls
d.c. reversing power
Audio output
Controlled rectifier
Voltage regulation
Battery charger
Ultra-high frequency oscillator

Tube Type	Gaseous	Type of Cathode	Type of Control	Use
Mercury-arc Rectifier				
Ignitron				
Thyratron				
Pentode				
Beam power				
Cathode ray				
Photoelectric				
Glow tube				
Rectigon or Tungar				
Magnetron				

8. In Fig. 13 find:

(a) The current in each conductor of the three-wire system

(b) The power transmitted to t load R_1, to the load R_2, the to power transmitted

(c) Find the total power input to t system

(d) Overall efficiency of transm sion

(e) Under what condition will t current in the middle conduct be zero?

GROUP F

1. The following operating data a taken from a test on a pulverized-fu fired boiler:

Boiler Rating	Half load	Full lo
Steam output lbs./hr.	150,000	300,0
Gas flow lbs./hr.	180,000	317,0
Air flow lbs./hr.	141,700	292,3
Gas Temp. to Air Htr. Deg. F.	600	
Gas Temp. from Air Htr. Deg. F.	300	
Air Temp. to Air Htr. Deg. F.	100	
Air Temp. from Air Htr. Deg. F.	496	

Determine: The coefficient of he transfer at half and full load for t air heater.

2. Describe and illustrate by sketch three types of centrifugal pump impe lers commonly used to pump water.

Illustrate the relative type of hea capacity characteristics.

3. Draw a set of head, capacity, ef

(Continued on page 36)

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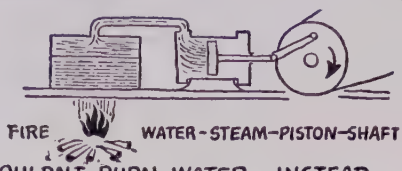
2



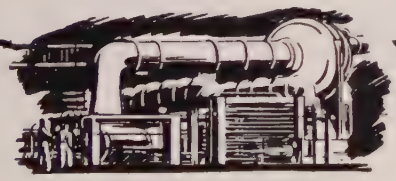
FIRE COULDN'T BURN WATER—INSTEAD IT CHANGED IT TO STEAM. SO MAN HARNESSED STEAM, USING FIRE INDIRECTLY TO PUSH A PISTON—TURN A WHEEL AND SHAFT....

3 FIRE-PISTON-SHAFT··

INVENTION OF THE INTERNAL COMBUSTION ENGINE ELIMINATED STEAM AS A LINK···BROUGHT FIRE CLOSER TO THE CRANK··· BUT THE FRICTION OF RECIPROCATING MACHINERY STILL LOSES POWER··· CAUSES WEAR.

4 THE GAS TURBINE··

NOW, IN THE GAS TURBINE, FIRE IS APPLIED DIRECT TO THE SHAFT. A COMPRESSOR SUPPLIES AIR TO THE COMBUSTION CHAMBER. FUEL BURNER HEATS AIR, GREATLY INCREASING ITS VOLUME. HEATED AIR RUSHES THROUGH TURBINE AND TURNS SHAFT. SOUNDS SIMPLE BUT MANY TOUGH PROBLEMS OF DESIGN AND METALLURGY HAD TO BE SOLVED TO MAKE IT PRACTICAL.....



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ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS

ENGINEERING EXAM . . .

(Continued from page 34)

ciency, h.p. characteristic centrifugal fan curves for:

(a) backward curved blade fan
(b) forward curved blade fan

4. A 1,200 r.p.m. motor is to drive a conveyor belt at 300 f.p.m. through a triple reduction gear system. Belt is 30 in. wide on a pulley 18 in. radius. The gears on the first reduction gear set have 25 teeth—75 teeth, and on the second set 18 teeth and 54 teeth.

(a) What must the gear ratio be on the third set of gears?
(b) If difference in belt tension is 50 lbs./in. of belt width and gear efficiency is 90%, what is the motor brake horsepower?

5. A plain medium carbon steel is heated above the critical temperature. State the name of each state that the steel passes through in quenching from this temperature. Give description of characteristic structure for each.

6. A survey of a power plant indicates a thermal efficiency of 20%. Fuel costs $5.00 per ton (10,000 B.t.u./lb.) and is 75% of total production cost. Distribution cost to consumer is equal to production cost.

What is the cost of electric energy distributed?

7. A standard steel stress specimen 0.505 in. in diameter is being tested in a tension test. At a load of 12,000 lbs. with a constant loading there is a short interval of drop of the beam; at a load of 22,000 lbs. the specimen breaks. The 2.00-in. gage length has increased to 2.57 in.

Determine:
(a) Stress at yield point
(b) Ultimate strength
(c) Per cent elongation

8. What quality does each of the following constituents impart to steel?

(a) Carbon
(b) Phosphorous
(c) Sulphur
(d) Manganese
(e) Aluminum
(f) Silicon
(g) Molybdenum
(h) Chromium

Removing Scorched Spots

Slightly scorched places on white shirts can be bleached white by dampening the spots and leaving the cloth beneath the ultraviolet rays of a sun lamp for ten minutes.

Phone Wake-Up Service

Sweden boasts a telephone wake-up service. Citizens simply pay the telephone company a small fee to be awakened each morning at a specified time.

PROFESSOR HORN . . .

(Continued from page 18)

luminating Engineering society for so time, was active on the board of ma gers of the Chicago section prior to entrance in the navy. While with Chicago section, he also served as vi chairman of the study club and, at same time, as national chairman of school lighting committee. At present is chairman of the research coordinati committee and a member of the Niaga Award committee. He is also a memb of the A.I.E.E. for which he served chairman of the Urbana section in 19

Golf and photography are his ma interests, but he does not have enou time to do more than take home mov of his two children, a boy and a girl, and 6 years old, respectively.

Tube May Revolutionize Televisio Transmission

A new vacuum tube amplifier, cently developed, may revolutionize lo distance telephone and television tra mission. Tests indicate the electron tu can be used to amplify dozens of f color or black and white television p grams simultaneously. Comparatively may be used for voice or video sign over a frequency band 40 times as wi as that of the best tube now in use, many times the amplification.

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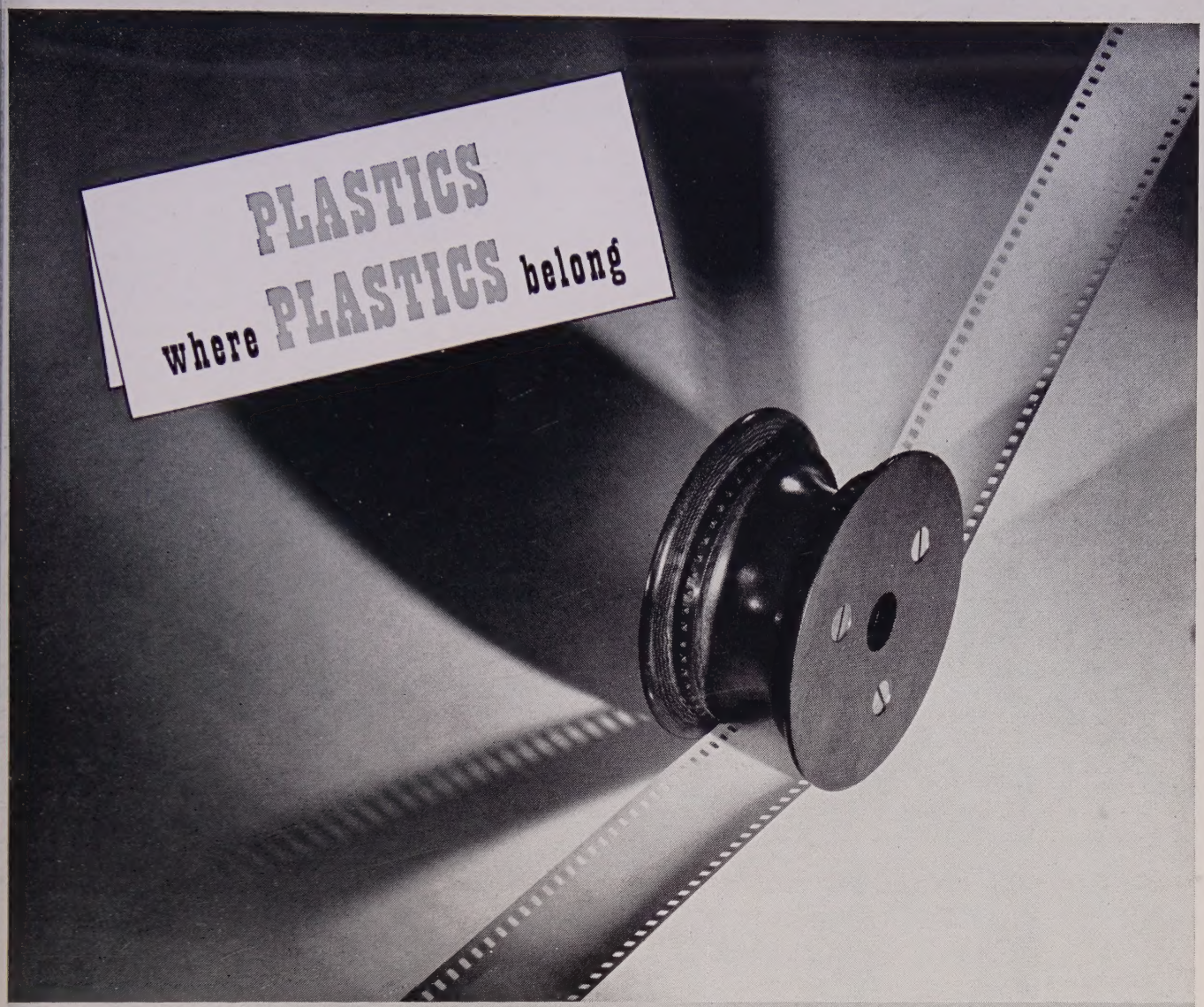

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SYNTHANE

NEW E.E. LABORATORY . . .

(Continued from page 10)

partment head's office. To adequately air condition the large interior rooms on the ground floors, the ventilation penthouse will be located on the roof to the rear of the servo-mechanism and instrument laboratories.

The second floor will be entirely devoted to electronics and communications. Along the Green street and Burrill avenue sides of the second floor will be classrooms. To the rear of the corridor will be placed laboratories for electronics, radio, ultra-high frequency, and transmission studies and two other small rooms for conference and apparatus construction work. The electronics and communications laboratories will contain recently designed tables with all necessary power sources readily available at each unit. A limited amount of equipment will be installed on the roof to aid in the study of communication antennae.

The University plant is to supply power as three-phase, four-wire a.c. at 4,160 volts. For d.c. conversion there will be also the ignitron, mercury-arc rectifier of 45 kilowatt capacity. The building and its equipment is estimated to cost on the order of $1,600,000. The design, as finally approved, is recognized to still be inadequate for the needs of present and future graduate students and University research. No space whatsoever has been allotted for illumination and high-voltage laboratories.

Graham, Anderson, Probst, and White, architects of Chicago, and Ernest Stouffer, University architect, are responsible for the design; John Felmley and Company, of Bloomington, is the general contractor. Credit for presentation of the material in this article goes to Prof. L. B. Archer, faculty chairman of the electrical engineering building committee.

NEW DEVELOPMENTS . . .

(Continued from page 2)

an electron beam; but this time it is fired at an angle to the sample so that it ricochets off and strikes against a strip of photographic film. The result is a pattern of black and white semicircles that are formed by electrons bouncing off the different faces of the block-like molecules of the oxide coating. By measuring the distance between the rings, the scientist is able to identify the chemical nature of the oxide.

The vacuum microbalance, which measures the rate at which rust and tarnish are built up, is a highly sensitive instrument constructed mainly quartz and hair-like tungsten wire a enclosed in a vacuum chamber. T sample to be weighed is hung on end of the balance beam while a co terweight is suspended from the oth A small amount of oxygen is then mitted into the chamber, forming oxide coating on the metal making gradually heavier. Movement of balance beam is watched through microscope, and the changes in weig (usually in millionths of a gram) recorded every few minutes.

Much more sweat than this, thou is required to finish the job. Air affe metal differently at various tempe tures, so it is necessary to conduct periments under conditions varying fr –290° F. to 930° F. Low temperatu are produced by immersing the sam in a bath of liquid air, while an elect furnace is used for elevated tempe tures.

The Birth of Television

Here's how television started: A te graph operator named May at Velent Ireland, notices that his instruments have erratically when the sun shines his selenium resistors. The principle volved inspires several inventors to p pose methods of picture transmissi during the next few years.

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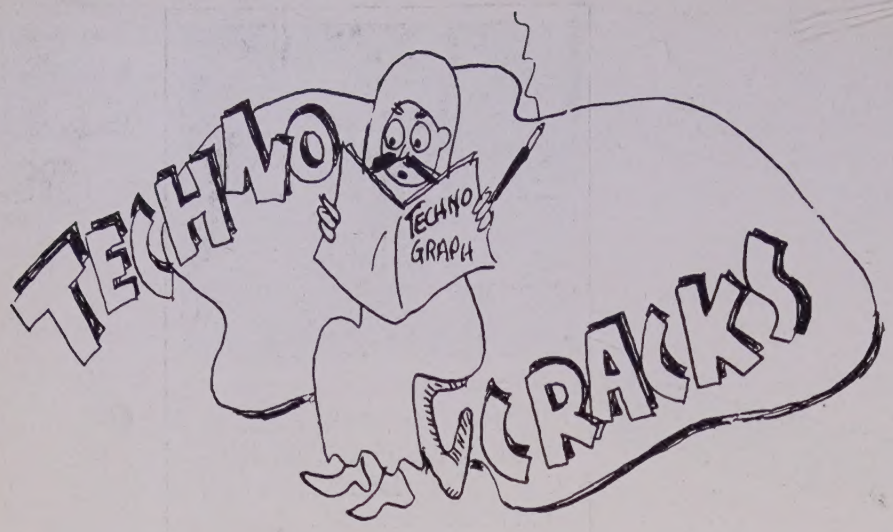

A girl who tries to talk her boy friend into buying her a dress shouldn't mind too much his trying to talk her out of it.

* * *

There was a drunk who was a habitual slot machine gambler. One day he staggered into the Automat and walked up to the sandwich section, deposited two nickels and a ham sandwich came out. Presently, after depositing 20 nickels, he had 10 sandwiches. The manager walked over to him and said, "Enough?" Whereupon the drunk exclaimed, "What! quit now when I am on a winning streak?"

* * *

"Do you mean to tell me," the judge said, "that you murdered that poor old woman for a paltry three dollars?"

"Well, judge, you know how it is. Three bucks here and three bucks there —it soon mounts up."

* * *

They had just returned from their honeymoon, and the bride was serving her first breakfast.

The engineer, who, all too late, was remembering his father's warning against committing the fatal error, gazed ruefully at the scorched toast, the messy looking fried egg, the blackened bacon, and the anemic-looking coffee placed before him.

"Hell, you can't cook, either!" he raged.

* * *

A young woman for whom a marriage with an old man was being arranged by her parents refused to go through with the ceremony because, as she put it, "I don't want to feel old age creeping up on me."

* * *

There was a young lady from Lynn
Who thought that to love was a sin,
But when she was tight
It seemed quite all right,
So everyone filled her with gin.

The city was crowded to its boundaries. The engineer was desperate for a room.

"Anything will do,' he said to the hotel clerk.

"I can let you have a cot in the ballroom," replied the clerk, "but there is a lady in the opposite corner, and if you don't make any noise, she'll be none the wiser."

"Fine," said the tired man, and into the ballroom he went. Five minutes later he came running out to the clerk.

"Say," he cried. "That woman in there is dead!"

"I know it," was the answer, "but how did you find out?"

* * *

Mary bought a new spring dress.
The style is very short,
So if she ever has it washed,
T'won't cover what it ought!

* * *

NIAGARA FALLS—The bride's second great disappointment.

Crossword Answer

P	A	C	I	N	O	T	T	I		D	R	A	W	
A	N	O	N		P	E	A	T		R	I	C	H	
N	O	W		C	A	S	T		W	A	S	T	E	
E	D		C	E	L	L		M	I	K	E		E	
L	E	M	O	N		A	W	A	R	E		C	L	
		O	R	T	S		E	K	E		D	U	E	
N	E	O	N		T	E	T	E		D	E	E	R	
E	R	N		L	O	P		R	A	I	L			
U	S		M	I	N	I	M		P	E	E	R	S	
T		S	O	L	E		O	T	I	S		A	T	
R	E	L	A	Y		B	O	A	S		A	D	A	
O	M	I	T		B	A	R	N		A	G	O	N	
N	U	T	S		B	A	E	K	E	L	A	N	D	

The minister's wife died rather suddenly, and such was his grief that he felt he could not go on with his sacred duties for the rest of the week. Perhaps it was his grief, too, which was responsible for the following message which he wired his bishop:

"Regret to inform you my wife has just died. Please send substitute for the weekend."

* * *

A story going the rounds of the studios in Hollywood is about the new find who was about to be starred in a picture.

In one scene the girl was supposed to jump from a very high cliff into the water.

Upon examining the jumping point and the landing place, the girl ran to the director and said, "I won't make that jump. I absolutely refuse to do it. There's only a foot of water at the bottom of the cliff."

"That's right," answered the director, "do you think we want you to drown?"

* * *

Laugh and the world laughs with you. Peel onions and you weep alone.

"I warned you about that new perfume"